

ripe." Similarly Alphonso Wood, who lived where *Dirca* abounds, said (1845), as already quoted by McVaugh, "Drupe oval (reddish)", and L. C. Beck, Bot. ed. 2: 307 (1848) said "reddish when ripe". Going outside New England and New York we find Victorin, who has many times collected *Dirca* in fruit, saying "Fruit: un drupe rouge, ovoide oblong" (Fl. Laurent. 362); Clements, Rosendahl & Butters, describing the shrub of Minnesota in Minn. Trees and Shrubs, 209 (1912), said "drupe oval-oblong, red"; while, writing from Iowa, Pammel, Man. Poisonous Pl. 643 (1911), definitely said "drupe red, oval, oblong". It is not reasonable to believe, as one might perhaps infer from the article which induced this note, that all the field-botanists, Jacob Bigelow, John Torrey, Alphonso Wood, L. C. Beck, Asa Gray, Clements, Rosendahl, Butters, Pammel, Victorin, my student, Mr. Bernard Boivin, who, when asked the color of the fruit near Montreal, promptly responded "purplish", and myself have mistaken yellow for purple or red. It is obvious that, whereas northward the ripe fruit generally becomes reddish or purplish, southward it often or always lacks this color and may become yellowish.

Furthermore, although McVaugh describes and illustrates the mature fruit as "spindle-shaped", with prolonged base and tip, the ripe fruits in the Gray Herbarium and that of the New England Botanical Club vary from slenderly rhomboid, with tapering tips, to thick-ellipsoid, with rounded ends, or obovoid, with broadly rounded summit, or even subglobose, with summit and base strongly rounded. The shape of the fruit seems to have no special geographic localization; the color possibly may have geographic significance. Here is an opportunity for close observation by those situated to make the observations.—M. L. FERNALD.

THE BROAD-LEAVED SPECIES OF POTAMOGETON OF NORTH AMERICA NORTH OF MEXICO

E. C. OGDEN

(Continued from page 105)

5. *P. PULCHER* Tuckerman

RHIZOME buff, often with dark red spots, .5–1 mm. in diameter. **STEM** simple, terete, 1–2.5 mm. in diameter, usually con-

spicuously black-spotted; stele with the proto-type pattern; endodermis of O-cells; interlacunar and subepidermal bundles absent; pseudo-hypodermis 1 cell thick. SUBMERSED LEAVES (excluding transition leaves) of two more or less distinct types, those of the lower part of the stem semi-opaque, oblong with rounded apices; those of the upper part of the stem translucent, lanceolate to lance-linear, not arcuate, apex acutish but not sharp-pointed, both types tapering at base to short petioles (up to 1.5 cm. long) or sometimes practically sessile; blades 8-14 (-18) cm. long, 1-2.5 (-3.5) cm. wide, nerves (9-) 11-21, outer ones marginal; margins entire; lacunae 4-8 rows each side of midrib. FLOATING LEAVES coriaceous, ovate to rotund; apex rounded or bluntly mucronate; base cordate or rounded; petioles 4-18 cm. long; blades 2-7 (-11) cm. long, 1.5-4 (-8.5) cm. wide, with (19-) 21-29 (-35) nerves, all of about equal prominence, as seen by transmitted light; lacunae none or very faint. STIPULES of the submersed leaves decaying early, those of the floating leaves persistent, narrowly triangular, obtuse when young, becoming acutish with age, 2-5 cm. long, 2-keeled. PEDUNCLES of rather even thickness throughout, 5-8 (-11) cm. long. SPIKES with about 10 whorls, in fruit 2-3.5 cm. long, .8-1.1 cm. thick. FLOWERS sessile or nearly so; sepaloïd connectives usually with a greenish cast, blades orbicular to elliptical, (1.2-) 1.5-2.5 (-3) mm. wide, claws, .4-.8 mm. long; anthers .8-1.4 mm. long. FRUITS obliquely ovate, rounded or cuneate at base, sides flat or slightly concave, (2.7-) 3-3.5 (-4) mm. long, (2.3-) 2.6-3.2 (-3.4) mm. wide; beak often prominent, up to .8 mm. long; keels usually prominent, acutish, the dorsal one often strongly developed, and sometimes with a basal lobe projecting below the point of attachment; exocarp mostly light brown, sometimes olive-green; endocarp with 3 prominent, acutish and somewhat muricate keels, beak linear, facial, about 1 mm. long, loop solid; apex of seed pointing .5-1.2 mm. above the basal end. Plants characterized by a conspicuously spotted stem, with large cordate floating leaves and lanceolate submersed leaves which taper rather abruptly to the base.

P. pulcher Tuckerm., Am. Journ. Sci. ser. 1: 45: 38 (1843); Morong, Mem. Torr. Club 3: no. 2: 16 (1893); Graebn. in Engler, Pflanzenr. 4: fam. 11: 67 (1907); Taylor, N. Am. Fl. 17: pt. 1: 21 (1909); Hagstr., Crit. Res. Pot. 152 (1916). *P. natans* sensu Bigel., Fl. Bost. 41 (1814), according to Tuckerm., Am. Journ. Sci. ser. 1: 45: 38 (1843). *P. lucens* var. ? *fluitans* (Roth) Gray, Man. ed. 2: 435 (1856), as to plants included in part, not *P. fluitans* Roth. ?*P. amplifolius* forma *amphibius* Benn., Journ. Bot. 42: 70 (1904). ?*P. amplifolius* var. *ovalifolius* Morong ex Benn., Journ. Bot. 42: 70 (1904); ?Graebn. in Engler, Pflanzenr. 4: fam. 11: 68 (1907). ?*P. amplifolius* var. *amphibius* (Benn.)

Graebn. in Engler, Pflanzenr. 4: fam. 11: 68 (1907). *Spirillus pulcher* Nieuwl., Am. Mid. Nat. 3: 16 (1913). *P. pulcher* forma *amphibius* Hagstr., Crit. Res. Pot. 153 (1916).

Shallow muddy pools, peaty pond-holes and sluggish streams chiefly of the Coastal Plain and Mississippi embayment, southern Nova Scotia, southern New Hampshire, south to Georgia, Texas, Oklahoma, Arkansas, Missouri and Minnesota. MAP 6. The following, selected from many specimens, are referred here. NOVA SCOTIA: Sears L., New Tusket, Digby Co., *Fernald & Long 23137*; Rhodeniser L., e. of Bridgewater, Lunenburg Co., *Fernald & Long 23138*. NEW HAMPSHIRE: Contoocook R., E. Jaffrey, *Rand & Robinson 1013*. MASSACHUSETTS: Foster's Pond, Andover, Essex Co., *Pease 2011*; Waushakum P., Ashland, Middlesex Co., June 1879, July 1, 1881, July 5, 1882 & Aug. 7, 1882, *Morong*; Spot P., Stoneham, July 4, 1852, *Robbins*; Whitman P., Weymouth, Norfolk Co., *Seymour 4151*; Sampson's P., Carver, Plymouth Co., *Fernald 750*; Uncatena, Elizabeth Islands, Dukes Co., *Fogg 2997*; L. Neeseponset, Dana, Worcester Co., *Goodale, Markert & Piper 96988*; Readville, Suffolk Co., June 16, 1878 & June 16, 1880, *C. E. Faxon*, also June 23, 1879, *Morong*; Natick, June 1, 1881 & Sept. 27, 1881, *Morong*; Nantucket, Nantucket Co., July 1887, *Morong*. RHODE ISLAND: ponds between Pilot Hill and Southeast Point, Block Island, Newport Co., *Fernald, Hunnewell & Long 8443*; Apponaug P., Apponaug, Aug. 26, 1880, *Morong*. CONNECTICUT: Fairfield, *E. H. Eames 8740 & 8746*; Killingworth, Middlesex Co., Aug. 19, 1915, *C. H. Bissell*. NEW YORK: River Head, Wading R., Long Island, May 25, 1878, *E. S. Miller*; Long Island, May 1890, *F. N. Tillinghast*; Valley Stream, Queens Co., Long Island, July 1886, *J. A. Bisky*; Arden, Staten Island, Oct. 9, 1886, *A. Hollick*; Rockland L., July 17, 1872, *Morong*. NEW JERSEY: Molly Wheaton Run, e. of Greenwich, Cumberland Co., *Fogg 2077*; Elmer, Salem Co., *Redfield 7996*; Cape May Court House, *Killip 30845*; Atlantic City, July 5, 1868, *C. F. Parker*. PENNSYLVANIA: Tullytown, Bucks Co., May 24, 1930, *W. M. Benner*. DELAWARE: Record's P., Laurel, Sussex Co., *Fogg 1840*; Glendaniel (Hudson) P., 2 mi. s. of Lincoln, Sussex Co., *Fogg 4504*; Indian R., Millsboro, Sussex Co., May 23, 1876, *A. Commons*; cedar swamp, New Castle Co., Sept. 20, 1867, *Commons*; Cherry Island Marsh, below Edgmoor, Wilmington, July 27, 1896, *Commons*; Canterbury, July 1874, *Wm. M. Canby*. MARYLAND: Marshyhope Creek, Federalsburg, Caroline Co., *Shreve 1622*; Blackwater R., Dorchester Co., *Shreve 1597*; Willards, Wicomico Co., Aug. 12, 1910, *J. J. Carter*. VIRGINIA: 4 miles n. w. of Waverly, Sussex Co., *Fernald & Long 5977*; brook entering Nowney Creek, Back Bay, Princess Anne Co., *Fernald, Griscom & Long 4535*; near Cornland, Norfolk Co., *Fernald & Griscom 4295*; pond near Luray Caverns, Luray,

June 1, 1909, *E. B. Bartram*; near Elko, *Grimes 4196*; vicinity of Cape Henry, *Killip 6896*; Great Dismal Swamp, *Kearney 1626*; Washington Canal, Dismal Swamp, *Boettcher 9*; Dahlia, Greensville Co., *Fernald & Long 8538*. NORTH CAROLINA: Cape Fear R., Wilmington, herb. *Hexamer & Maier 466*; Hendersonville, Henderson Co., *Biltmore Herb., 5980^a*. GEORGIA: near Huguenin, Sumter Co., *Harper 1402*; Brier Creek, Screven Co., *Harper 2088*. FLORIDA: Miccosukee L., *Sperry 509*. OHIO: Baumgartner's L., Jackson Twp., Franklin Co., Aug. 16, 1929, *H. T. Flint*. INDIANA: pond about 3½ mi. n. w. of Grayville, Sullivan Co., *Deam 25704*; Pine Station, Lake Co., June 1884, *E. J. Hill*; Pine, Lake Co., June 21, 1897, *A. M. Chase*. KENTUCKY: Lexington, 1836, *C. W. Short*; s. e. of Mammoth Cave, Edmonson Co., *Svenson 156*. TENNESSEE: Goose P., Pelham, Grundy Co., *Svenson 9108 & 10150*. ALABAMA: Montgomery, Oct. 16, 1888, *Chas. Mohr*; slough along main highway 5 mi. w. of Tuscaloosa, Tuscaloosa Co., *Svenson 9427*. ILLINOIS: Mason Co., Aug. 1860 & Aug. 1861, *E. Hall*; Athens, Menard Co., 1861, *E. Hall*. MINNESOTA: Colby L., Taylors Falls, *Metcalf 1291*. MISSOURI: St. Louis, 1838, *N. Riehl*, also Aug. 1847, *Geo. Engelmann*; Montier, June 8, 1890, *Bush*; north of Flatwoods, Ripley Co., *Steyermark 14245*; Little Black River, Pleasant Grove, Ripley Co., *Mackenzie 359*; between Gladden & Timber, Dent Co., *Palmer & Steyermark 41417*; Hogan, Iron Co., July 15, 1898, *C. Russell*; Nettleton, Caldwell Co., May 7, 1893, *H. Eggert* (M, mixed with *P. amplifolius*; F, NY, US, not mixed). ARKANSAS: Nettleton, Craighead Co., May 7, 1893, *Eggert*; Greene Co., May 7, 1893, *Eggert*; Judsonia, June 13, 1877, *H. S. Reynolds*. LOUISIANA: Calcasieu R., St. Martinville, Oct. 7, 1893, *A. B. Langlois* (US). OKLAHOMA: Page, Leflore Co., *Blakley 1453*, also *E. J. Palmer 33310*. TEXAS: Lindale, April 23, 1901, *Reverchon* (M).

Tuckerman's original description of *P. pulcher* is brief but leaves little doubt as to what plant he referred to this species. He was certainly in error however, when he stated that it has "much larger seeds" than *P. praelongus*. He was quite familiar with the *P. praelongus* of Fresh Pond, Cambridge, where it grew abundantly and was collected there by Boott, Tuckerman, Robbins, Morong, and the Faxons. However, all of the Fresh Pond material of *P. praelongus* seen by me lacks mature fruits, and it may be that Tuckerman did not at that time realize how large the mature fruits of that species really are. His supplementary description¹ is absolutely conclusive as to the plant he was describing.

¹ Edward Tuckerman, *Am. Journ. Sci.* ser. 2: 6: 224 (1848).

The forma *amphibius* and var. *ovalifolius* which Bennett referred to *P. amplifolius* may possibly be *P. pulcher*. They have been discussed under *P. amplifolius*. Hagström's forma *amphibius* is the terrestrial state so common to *P. pulcher*.

6. *P. NODOSUS* Poiret

RHIZOME white, suffused or spotted with rusty red. **STEM** simple, terete, often pressing very flat, 1–1.5 (–2) mm. in diameter; stele with the trio-type pattern, with the phloem on the inner face of the trio-bundle appearing as one patch; endodermis of O-cells (rarely more thickened on the inner face and appearing as U-cells); interlacunar and subepidermal bundles absent; pseudo-hypodermis absent. **SUBMERSED LEAVES** thin, linear-lanceolate to broadly lance-elliptical, 9–20 cm. long, 1–3.5 cm. wide, tapering gradually at base into a petiole 2–13 cm. long, tapering gradually to an acutish (but not sharp pointed) apex; nerves 7–15; lacunae of 2–5 rows along the midrib; margin of young blades with fugacious translucent denticles. **FLOATING LEAVES** coriaceous, with long petioles; blades lenticular to elliptical, cuneate or somewhat rounded at base, apex acutish to rounded (sometimes with an obtuse mucro), (3–) 5–9 (–11) cm. long, (1.5–) 2–4 (–4.5) cm. wide; nerves (9–) 13–21; lacunae rarely present. **STIPULES** of submersed leaves brownish, often delicate and decaying early, linear, acute or obtuse, 3–6 (–9) cm. long; those of the floating leaves similar but usually broader at base and more or less 2-keeled. **PEDUNCLES** usually thicker than the stem, 1.5–2.3 mm. in diameter, 3–15 cm. long. **Young SPIKES** compact but becoming loose at anthesis, of 10–15 (–17) whorls of flowers; at maturity usually not densely fruited, 3–6 (–7) cm. long, .8–1 cm. thick. **FLOWERS** sessile; sepaloïd connectives greenish or brownish, orbicular or elliptical, (1.4–) 1.6–2.2 (to 2.6 on basal flowers) wide; anthers 1–1.4 mm. long. **FRUITS** obovate, 3.5–4 (–4.3) mm. long, 2.5–3 mm. wide; keels prominent, the dorsal strongly developed, especially upward, the laterals often muricate; beak facial, short; exocarp of mature fruits brownish or reddish; endocarp with keels strongly developed, dorsal often .5 mm. wide, the laterals strongly muricate, beak linear, erect, up to 1 mm. long, loop solid; apex of seed pointing a little above the basal end.—A variable species characterized by floating leaves cuneate at base, narrowly lanceolate submersed leaves tapering gradually to each end, and reddish fruits with strongly developed, often muricate, keels.

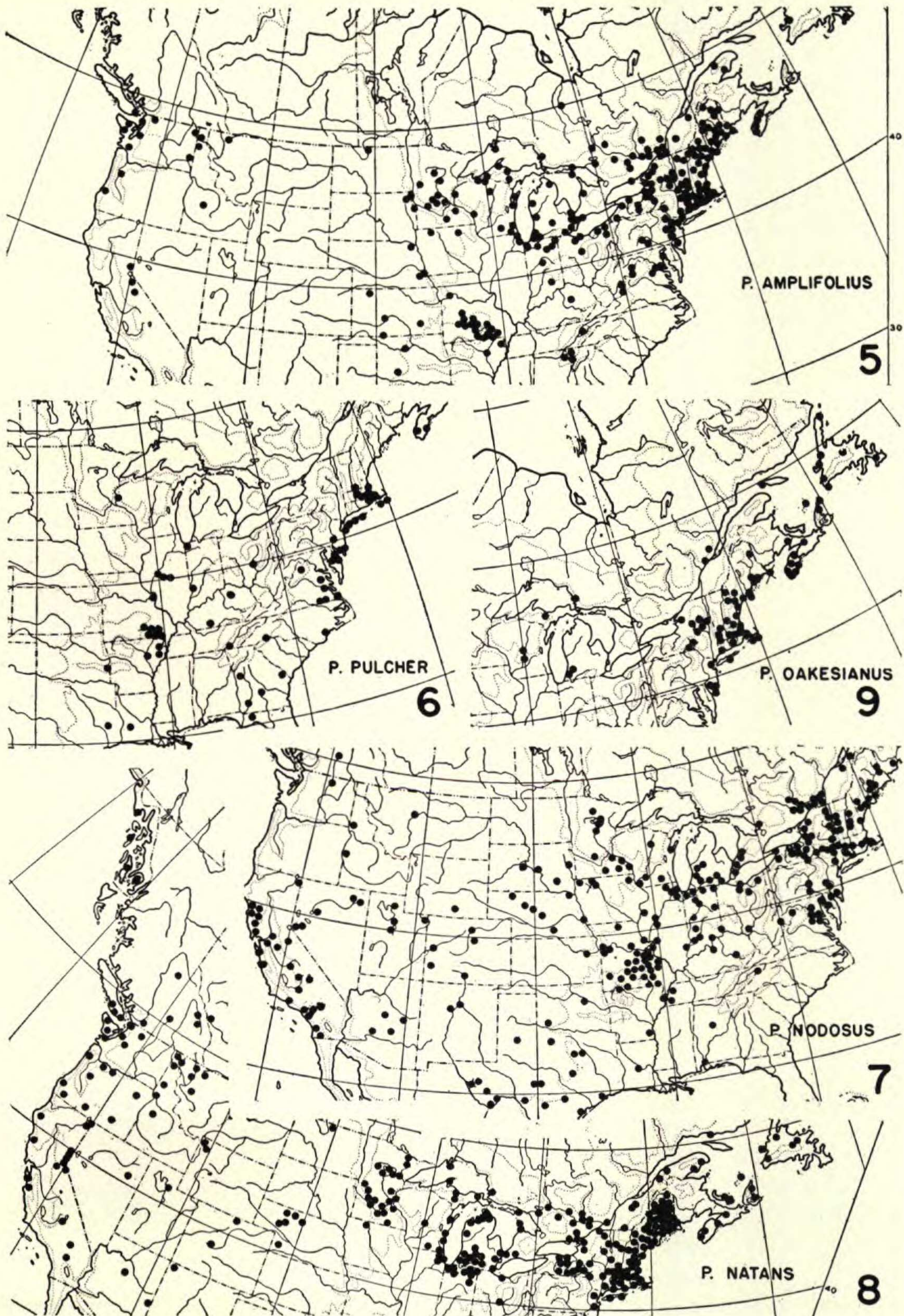
P. nodosus Poiret in Lamarck, Enc. Meth. Bot., Suppl. 4: 535 (1816); Hagstr. Crit. Res. Pot. 183 (1916). *P. americanus* C. & S., Linnaea 2: 226 (1827); Benn., Journ. Bot. 31: 297 (1893); Taylor, N. Am. Fl. 17: pt. 1: 19 (1909). *P. occidentalis* Sieber

ex C. & S., *Linnaea* **2**: 224 (1827); Taylor, *N. Am. Fl.* **17**: pt. 1: 20 (1909). ?*P. montanus* Presl, *Rel. Haenk.* **2**: 85 (1835). *P. natans* var. *fluitans* sensu Torr. *Fl. N. Y.* **2**: 244 (1843). *P. lonchites* sensu Tuckerm., *Am. Journ. Sci.* ser. 2: **7**: 350 (1849), and subsequent Am. authors, not Tuckerm., *ibid.* ser. 2: **6**: 226 (1848). *P. lucens* var. ? *fluitans* (Roth) Gray, *Man. ed.* **2**: 435 (1856), in part. ?*P. plantagineus* var. *jamaicensis* Grisebach, *Fl. Brit. W. Ind.* 506 (1861). ?*P. mexicanus* Benn., *Journ. Bot.* **25**: 289 (1887); ? Morong, *Mem. Torr. Club* **3**: no. 2: 22 (1893); ? Raunk., *Bot. Tidskr.* **25**: 266 (1903); ? Graebn. in Engler, *Pflanzenr.* **4**: fam. 11: 57 (1907); ? Taylor, *N. Am. Fl.* **17**: pt. 1: 18 (1909). *P. lonchites* var. *novaeboracensis* Morong, *Mem. Torr. Club* **3**: no. 2: 20 (1893). *P. americanus* var. *novaeboracensis* (Morong) Benn., *Journ. Bot.* **31**: 297 (1893). *P. pennsylvanicus* var. *portoricensis* Graebn. in Urban, *Symb. Antill.* **4**: 73 (1903), at least in part. *P. Nuttallii* var. *portoricensis* Graebn. in Engler, *Pflanzenr.* **4**: fam. 11: 56 (1907), at least in part. *P. fluitans* subsp. *americanus* (C. & S.) Graebn. in Engler, *Pflanzenr.* **4**: fam. 11: 60 (1907). *P. fluitans* subsp. *americanus* proles *novaeboracensis* (Morong) Graebn. in Engler, *Pflanzenr.* **4**: fam. 11: 62 (1907). ?*P. coloratus* var. *jamaicensis* (Griseb.) Graebn. in Engler, *Pflanzenr.* **4**: fam. 11: 69 (1907). ?*P. insulanus* Hagstr., *Crit. Res. Pot.* 154 (1916). *P. rotundatus* Hagstr., *Crit. Res. Pot.* 153 (1916). *P. fluitans* sensu Am. authors, ? not Roth, *Tent. Fl. Germ.* **1**: 72 (1788). *Spirillus lonchites* (Tuckerm.) Nieuwl., *Am. Mid. Nat.* **3**: 16 (1913).

A widespread species of ponds and streams, generally in flowing water, southern Quebec and New Brunswick to southern British Columbia, south to Virginia, Tennessee, Louisiana, and California. MAP 7. Mexico and the West Indies, South America (rare), Eurasia, Africa. The following, selected from a large series, are representative: QUEBEC: St. Lawrence River, St. Jean-Port-Joli, L'Islet Co., *Svenson & Fassett 934*; Saint-Lambert de Lauzon, Levis Co., *Victorin, Rolland & Meilleur 43858*; Sainte-Rose, Laval Co., *Victorin & Rolland 43565 & 49304*, also *St. Cyr 3030*; Longueuil, Chambly Co., *Rolland 43359*; Angers, Ottawa R., *Rolland 19269*; Wakefield, *John Macoun 62015 & 62016*; Sainte-Sulpice, L'Assomption Co., *Ricard & Boivin 342*. NEW BRUNSWICK: St. John R., Lincoln, Sunbury Co., *Fassett 2149*. MAINE: Houlton, Aroostook Co., Aug. 26, 1897, *Fernald*; Pushaw Stream, Old Town, Penobscot Co., *Ogden, Steinmetz & Prince 1596*, also *Steinmetz 326*. Androscoggin R., Gilead, Oxford Co., Oct. 1, 1897, *Furbish*; Sydney, Kennebec Co., *Fernald & Long 12389*; St. George R. near Indian Garden, Warren, Knox Co., Aug. 15, 1913, *Norton*. NEW HAMPSHIRE: Connecticut R., vicinity of Hanover, Grafton Co., Aug. 17, 1876, *H. G. Jesup*; Cornish, Sept. 2, 1886, *F. H. Knowlton*. VERMONT: Ferrisburg

and Vergennes, many collectors; Lake Champlain, Orwell, Addison Co., *Cushman 6007*; Hydeville, Rutland Co., July 21, 1892, *Eggleston*; Winooski R., Burlington, Aug. 25 & 27, 1885, *Morong*. MASSACHUSETTS: Concord, Aug. 12, 1887, *E. S. Hoar*; Mystic P., Oct. 1, 1865, herb. *Wm. Boott*; Winchester, Sept. 1, 1880, Aug. 8 and Aug. 29, 1881, *Morong* (the latter mixed with *P. nodosus* × *epihydus* in Gray Herb.); Connecticut R., Springfield, Sept. 6, 1864, *Robbins*; Harmon P., Sheffield, Berkshire Co., Aug. 12, 1914, *R. Hoffmann*; Pauls Bridge, Neponset R., Readville, May 30, 1881, herb. *E. & C. E. Faxon*; Egremont, *Standley & Killip 7649*. CONNECTICUT: New Hartford, *Driggs 40*; Twin Lakes Station, Salisbury, Litchfield Co., Aug. 20, 1935, *Fernald & Ogden*; Lake Whitney, New Haven, Sept. 24, 1886, *W. A. Setchell*; Housatonic R., Stratford, 1845, *Robbins*; Housatonic R., Newtown, Fairfield Co., *A. E. Blewitt 3657*. NEW YORK: N. Beaver Creek, Haynes Hill, W. Fort Ann, Washington Co., Aug. 26, 1914, *Burnham*; Guildenland, Albany Co., *House 21774 & 22044*; Ellisburg, Jefferson Co., *House 19852 & 20002*; Ithaca, Tompkins Co., *R. Hitchcock 11167 & 11168*; Lake Erie, Buffalo, Aug. 20 & 25, 1886, *Morong*; Niagara Rapids, *E. Tuckerman* (*P. lonchites* of Tuckerman's supplementary description, but not of original description); pool near White Creek, DeKalb Co., *Phelps 1091*; Grass R., Canton, *Phelps 1665*; Raquette R., above Potsdam, St. Lawrence Co., *Muenschler & Clausen 3751 & 3752*; Float Bridge, Rochester, *Baxter 5389*; Chemung R., Chemung Co., *Lucy 424 & 10816*. NEW JERSEY: Oldmans Creek, 1.5 mi. n. n. e. of Eldridges Hill, Salem Co., *Fogg 6794*. PENNSYLVANIA: Harrisburg, Sept. 1893, *John K. Small*; Penn's Creek at the "Swinging Bridge," Selinsgrove, Snyder Co., *Moldenke 4208*; Sellersville, 1868, *C. D. Fretz*; vicinity of McCalls Ferry, York Co., *Rose & Painter 8205*; Chester Co., July 1858–1864, *S. P. Sharples 303*. DELAWARE: Shelpot Creek, Wilmington, June 17, 1879, *A. Commons*; Brandywine, Wilmington, Aug. 17, 1896, *A. Commons*; White Clay Creek, Stanton, Sept. 4, 1896, *A. Commons*. MARYLAND: Chicomuxen Creek, *Tidestrom 7637*; Mill Creek, Chesapeake Bay region, *Shull 95*; Cabin John, Montgomery Co., *Painter 1189*, also *Dowell & Painter 5385*; Chesapeake Canal above Cabin John, near Lock 13, *Leonard & Killip 603*; Spesutie Island, Harford Co., *Moldenke 9396*; Great Falls, *House 517*. DISTRICT OF COLUMBIA: Arlington Junction, Sept. 28, 1897, *E. S. Steele*; C. & O. Canal above Georgetown, Aug. 9, 1897, *T. H. Kearney*; Georgetown, *Van Eseltine & Moseley 202*; Fish Ponds, *Shull 39*. WEST VIRGINIA: Cacapon R., Hardy Co., Aug. 13, 1930, *W. V. U. Bot. Exped.*; Tygart R., Beverly, Randolph Co., *Millspaugh 457*. VIRGINIA: Four-Mile Run, Chesapeake Bay region, *Shull 474*; near Leedstown, *Tidestrom 7741*; Potomac R., The Dyke, *Tidestrom 7183*; Dyke,

Fairfax Co., *Metcalf & Sperry 1622 & 1630* Hunting Creek, *McAtee 2374*. ONTARIO: Rideau R., at Billings Bridge, Ottawa, *Malte 118274*; Mississippi R., Galetta, Carleton Co., *Ogden & Bolan 1629 & 1630*; Chatham, *Cain 935*; Nation R., Casselman, Aug. 21, 1884, *John Macoun*, also *Malte 118275*; Nation R., Russel, *Macoun 22177*; Maitland R., Goderich, *Macoun 26839*; Golden L., Renfrew Co., *Macoun 22177*, Dunnville, *John Macoun 26841*; near Lake Muskoka, Aug. 29, 1899, *D. LeRoy Topping*; L'Original, *Rouleau 304*. MICHIGAN: Kalamazoo R., Allegan Co., *Wight 86, 87a, 87b, 87c, 88, 98 & 123*; Grand Rapids, July 21, 1895, *W. E. Mulliken*; Vandercooks L., Jackson Co., July 21, 1898, ex herb. *S. H. & D. R. Camp*; Pine L., Aug. 20, 1892, *C. F. Wheeler*; Gun R., Barry Co., July 1926, *Oosting*; Freemont L., Newaygo Co., July 9, 1926, *Oosting*; Black L., Ottawa Co., Aug. 27, 1926, *Oosting*; Huron R., 3½ mi. s. e. of Ann Arbor, Washtenaw Co., *Hermann 9383*. OHIO: Brady L., Portage Co., July 29, 1913, *R. J. Webb*; Put-in-Bay, Aug. 1898, *A. J. Pieters*; Presque Isle Point, Sandusky Bay, Aug. 19 & 29, 1895, *E. L. Moseley*; Buckeye Creek, Liberty Twp., Jackson Co., *Pontius & Bartley 18*. INDIANA: Walnut Creek, 2 mi. n. e. of Bainbridge, Putnam Co., *E. J. Grimes 594*; Aberdeen, Ohio Co., *Deam 56783*; Lake Maxinkuckee, *Scovell 32*; Tippecanoe R., 6 mi. n. and 1 mi. e. of Winemac, Pulaski Co., *Welch 2106*; Calumet R., Clarke, *Lansing 1059*; n. of Spencer, Owen Co., *Deam 38978*; mouth of John's Creek, Wells Co., July 2, 1905, *Deam*. KENTUCKY: 3 mi. s. of Richmond, Madison Co., *Svenson 7216*; Kentucky R., June–July, *Dr. Short*; Ohio R., Louisville, Sept. 16, 1854, *C. Mohr*. TENNESSEE: n. fork of Holston R., near Kingsport, Hawkins Co., *Sharp & Underwood 33521*; Reelfoot L., Lake Co., *Demaree 7051 & 7132*. ALABAMA: Mobile R. near Piute Island, May 28 & July, 1884, *Chas. Mohr*; East L., near Birmingham, Jefferson Co., *Biltmore Herb. 5806^b*. WISCONSIN: between Duck Creek R. and Bars Channel, Green Bay, July 28, 1891, *Schuette*; Wisconsin R., near Newport, Delton, Sauk Co., Aug. 26, 1906, *A. B. Stout*; Pickerel Slough, Prairie du Chien, Crawford Co., *Fassett 4350*; Lake Mendota, Middleton, Dane Co., *Fassett 3148*; near Tomahawk, *Cheney 1086*. ILLINOIS: Calumet L., Chicago, *Chase 1420*; Wolf L., Chicago, June 10, 1911, *Sherff*; Du Page R., Naperville, June 22, 1895, *L. M. Umbach*; Ogden Ditch, Summit, *Hill 159, 1909*; Lyons Twp., Cook Co., *Hill 151, 1901*; Fox R., Richland Co., *Ridgway 3318*; Lake Lawrence, Lawrence, *Ridgway & Eaton 3425*; Swan L., near Grafton, Calhoun Co., *Metcalf 1105*; Oquawka, 1879, *H. N. Patterson*. MINNESOTA: Wabana L., Itasca Co., *Metcalf 1471*, also *Kubichek 148 & 149*; Borden L., Garrison Twp., Crow Wing Co., *Hotchkiss & Jones 480 & 4109*; Ft. Snelling, June 1895, *E. P. Sheldon*, also *Mearns 805*; Minn. R. bottoms, Dakota



RANGES OF POTAMOGETON

Co., June 1895, *E. P. Sheldon*; Green L., Kandiyohi Co., *Metcalf 2046*; Mazaska L., Rice Co., *Keck & Stilwell 401*; Courtland, Nicollet Co., July 1892, *C. A. Ballard*. IOWA: Fayette, July 1893, *B. Fink*; Estherville, Aug. 7, 1897, *R. I. Cratty*; Granite, Lyon Co., Aug. 4, 1896, *B. Shimek*; Des Moines R., July 1881, *R. I. Cratty*. MISSOURI: along Current R., near Doniphan, Ripley Co., *Steysmark 9233, 14257 & 14259*; Gasconade R., s. e. of Hazel Green, Pulaski Co., *Steysmark 25102 & 25103*; n. w. of Waynesville, Pulaski Co., *Steysmark 25249*; Gasconade R., n. e. of Vienna, Maries Co., *Steysmark 25603*; Buffalo Creek, s. e. of Louisiana, Pike Co., *Steysmark 25876*; Sect. 6, w. of Lynchburg, Laclede Co., *Steysmark 27148*; Osage R., Mary's Home, Miller Co., *Steysmark 13083 & 13097*; Iron Mountain L., *Metcalf 842*; Killarney L., East Arcadia, *Metcalf 845*; Ice P., Unionville, *Metcalf 1071*; Duck L., Platte Co., *Metcalf 1024*; Goose P., Springfield, *Standley 9780*; Gascondy. *Emig 224*; e. of Ashland, Boone Co., *Drouet 3028*; n. w. of Joplin, Jasper Co., *Palmer 21526*; Meramec, Sept. 2, 1886, *Eggert*; Meramec R., St. Louis Co., Sept. 12, 1886, *Eggert*; Atherton, Jackson Co., *Bush 630*; Sheffield, Jackson Co., Aug. 4, 1896, *Mackenzie*; White R., Forsythe, Taney Co., *Trelease 817*. ARKANSAS: Big L., Hornersville, *Metcalf 636*; Saline R., Ozment Bluff, Drew Co., *Demaree 17893*. SOUTH DAKOTA: Sioux R., near Brookings, Sept. 1, 1893, *T. A. Williams*; Medicine Creek, near Canning, Aug. 16, 1892, *T. A. Williams 1*; s. of St. Pierre, Stanley Co., *Over 17432*. NEBRASKA: Niobrara R., southwest of Valentine, *Tolstead 637*; Middle Loup R., near Norway, Thomas Co., *Rydberg 1421*; Anselmo, July 6, 1889, *Weber 6*; Lake Manawa, near Omaha, *Lawton 50*. KANSAS: Topeka, Aug. 1870, *E. Hall*. OKLAHOMA: near Cache, Comanche Co., *Stevens 1364* (G, US, mixed with *P. amplifolius*, NY, not mixed); Sapulpa, *Bush 1207*. TEXAS: Comanche Spring, New Braunfels, *Lindheimer 1234*; Little Aguja Canyon, Jeff Davis Co., *Moore & Steysmark 3077*; Haley Ranch, Brewster, *Cory 9198*; Victoria, *Lindheimer 393*; Lake Polk, near Temple, Bell Co., *Wolff 3290*; Dallas, June 25, 1929, *Mary R. Stephenson*; Lubbock, *Reed 3168*; Nueces R., Uvalde, Uvalde Co., *Palmer 33707*; Houston, Harris Co., *Palmer 11952*; Sycamore Creek, Fort Worth, *Ruth 141*. MONTANA: Great Falls, *R. S. Williams 285*. IDAHO: Payette, *Henderson 4882*. WYOMING: Ft. Steele, Carbon Co., *Goodding 539*. COLORADO: Lee's L., *Crandall 2530*; Alamosa, *Clements 305*; Rio Grande, Alamosa, *Shear 3745*; Owen's L., Boulder, *Daniels 683*; Gunnison R., Grand Junction, Mesa Co., *Biltmore Herb. 5806^a*. UTAH: Hills Park, Salt Lake City, June 29, 1908, *Mrs. J. Clemens*; Hill Creek, Uinta Basin, Uinta Co., *Graham 9821*; near Goshen's fixed sand-dunes, Utah Co., *Garrett 3958*; Corinne, *Wetmore 395*. NEVADA: Hot Creek, near Gold Creek, Elko Co., *P. B. Kennedy*

4476; Glendale, Truckee valley, Washoe Co., *P. B. Kennedy* 3041; Sparks, near Reno, *A. E. Hitchcock* 444; North Fork, *A. E. Hitchcock* 1034; Wadsworth, *Tidestrom* 10655. NEW MEXICO: Santa Fe, *Fendler* 837; San Jose, near Santa Fe, *Arsène & Benedict* 16636; Albuquerque, Oct. 13, 1894, *C. L. Herrick*. ARIZONA: Camp Verde, *W. W. Jones* 432; Lower Oak Creek, *Fulton* 9703; Granite Reef Dam, Maricopa Co., *Peebles* 14190; Pinal Creek, *Toumey* 496; Beaver Creek, *MacDougal* 543. CALIFORNIA: Pit R., at Lookout, Modoc Co., Aug. 24, 1899, *M. S. Baker*; Big R., Mendocino Co., *McMurphy* 192; Russian R., n. of Cloverdale, Mendocino Co., *Heller* 5824; Mormon Creek, Tuolumne Co., *Williamson* 309; Santa Cruz, *M. E. Jones* 2310; Visalia, Tulare Co., *Coville & Funston* 1278; Bakersfield, Kern Co., *Coville & Funston* 1244; Laguna Lakes, Orange Co., *Street & Williams*, 2689; Colton, San Bernardino Co., *Parish* 2106 & 2128; Deep Creek, San Bernardino Mts., San Bernardino Co., *L. C. Wheeler* 1974. WASHINGTON: Okanogan R., *Sereno Watson* 398. BRITISH COLUMBIA: Kamloops, June 26, 1889, *John Macoun* 2970.

P. fluitans of European authors consists of two quite independent plants: one a fruiting plant with an endodermis of O-cells and no bundles in the cortex; this occurs in North America. The other is a sterile plant with an endodermis of U-cells and with numerous bundles in the cortex; this plant is thought to be a hybrid, *P. lucens* × *P. natans*. Roth's original description,

P. foliis inferioribus longissimis, lanceolatis, acuminatis, membranaceis; superioribus ovali-lanceolatis, coriaceis: omnibus petiolatis.

Habitat in fossis profundis lente fluentibus et in *Hunte fluuio Ducatus Oldenburgensis*,

would include both plants. The fact that no fruits are described does not at all mean that Roth's plant lacked them, for at that time vegetative characters were given prominence and the fruits often ignored. Of the thirteen species of *Potamogeton* described in Roth's flora where *fluitans* is proposed as new, not one of them has any mention of fruit. Even if Roth's specimens lacked fruit, it does not follow that they were the non-fruiting entity with bundles in the cortex. Bennett thought the name *fluitans* ought to be kept for the hybrid, saying, "We have no certain knowledge of any specimen of Roth's species being preserved in any herbarium; but there are at Munich specimens in Schreber's herbarium, named as such and gathered 'In Seebach, 1775,' and others, 'In Seebach, 1782.'" It seems to me a reason-

able inference that these specimens are from (or seen by) Roth; the more so because there are other species in the same collection actually received from Roth, and signed by him. They are the plant we call *fluitans* in England (hybrid?)”¹. Later he adds, “The following extract from Roth’s *Catalecta Botanica* (fasc. 1, p. 31, 1797) will show that Schreber’s specimens in the Munich Herbarium are, as I supposed, the plant of Roth: . . . ‘Prope *Erlangam* etiam observavit Ill. Praes. *de Schreber*’”². To this Raunkiaer answers, “that because a herbarium contains plants actually from Roth it can not be necessary that other plants in the same herbarium should be from him. The specimens from the Munich herbarium mentioned have been examined by me and that they belong to the barren form of *P. fluitans* is true enough but they can not in the least be considered original specimens.”³ He then attempts to show that in the Bremen herbarium there is a specimen which has a good chance of being the original; and it is the plant with O-endodermis and lacking bundles in the cortex. He also states that in the “Petersburg herbarium and examined by me . . . three specimens . . . may well be original specimens.”⁴ As these specimens also proved to be the fertile plant he concludes that we should retain the name *P. fluitans* for the fertile species which lacks strengthening tissue in the cortex. Hagström agrees that “This proof would be very strong, if those specimens examined also really corresponded with the original description by Roth ‘foliis inferioribus longissimis’ . . . which they can scarcely be said to do.”⁵ From Roth’s later and more detailed description⁶ it does appear that he then was at least including the barren form with his *P. fluitans*. Also, it would seem, if Roth had in mind the specimens in the Bremen and Petersburg herbaria when drawing up his original description, that he would have mentioned them in his *Catalecta Botanica*, as he does mention the Schreber specimens. It thus appears that the evidence that *P. fluitans* should be retained for the fruiting plant is not strong, and I am

¹ Arthur Bennett, *Journ. Bot.* 31: 296 (1893).

² ———, *Journ. Bot.* 39: 198 (1901).

³ C. Raunkiaer, *Bot. Tidskr.* 25: 278 (1903).

⁴ ———, *Bot. Tidskr.* 25: 278 (1903).

⁵ J. O. Hagström, *Crit. Res. Pot.* 184 (1916).

⁶ A. G. Roth, *Tent. Fl. Germ.* 2: 202 (1789).

inclined to agree with Hagström in treating it as a *nomen confusum*. Hagström takes up for this plant *P. nodosus* Poiret.

P. nodosus Poiret is based on a plant from the Canary Islands, collected by Broussonet. This specimen should be in the Paris Museum. A photograph of it was, some years ago, requested by the Gray Herbarium but not received. The original description agrees with the specimens here placed under that name, but is not conclusive. Until it can be shown that the Canary Island plant is not the wide-ranging species correlated with it, it is best to retain Poiret's name, as taken up by Hagström, for the American plant.

The species in North America is a rather variable one. The floating leaves especially vary greatly in size. Morong's var. *novaeboracensis* (of *P. lonchites*) covers the large-leaved form, which in America is less frequent than the narrow-leaved form. In Europe the broad-leaved plants are the more common. Which form is represented by the Broussonet specimen I am at present unable to say, but at any rate this size-variation appears not to be worth nomenclatorial distinction. The robustness of the plant does not correlate with other variations and the intermediate forms are the most common. Even the fruits of this species show a diversity in the prominence of the keels, but this, too, does not correlate with other differences, and sometimes a marked variation is found on an individual plant. When typically developed, the keels are strongly prominent; their lack of development is probably mostly due to a rapid maturation—a ripening before the endocarp is fully formed. Unkeeled fruits invariably have aborted embryos.

From Missouri westward, this species tends to have smaller floating leaves of a more yellowish green than those typical of the east. Correlated with this is a smaller fruit with less strongly developed keels (*P. rotundatus* Hagstr.). However, the typical large green leaf is also common in the west, as well as all degrees of intermediate forms. Also, some specimens with small yellowish leaves may exhibit fruits as strongly keeled as those of the typical eastern plants.

In 1848, Tuckerman described as *P. lonchites* a plant with "stem . . . much branched, . . . Submersed leaves . . . with 6-8 prominent nerves," (making no mention of a

petiole) and "floating leaves delicate, . . . always more or less tapering above and waved above, . . . stipules . . . shortish . . . Nutlets small . . . obscurely tricarinate." He stated that it was "near to *P. heterophyllus* of authors, (*P. gramineus*, Fr., Koch)." ¹ The following year he remarked further on his *P. lonchites* and spoke of "a remarkable state of this species . . . In this the stem is simple . . . and the . . . leaves are either all coriaceous and floating, or only the lowest submembranaceous, . . . the whole habit of which accords, often strikingly with that of *P. fluitans*; but its strongly marked fruit at once refers it to the present species. The published description of the fruit of this species was from immature nutlets. The following is taken from perfectly ripe ones . . . The lateral keels are conspicuous when dry . . . The exocarp being removed, the back appears acutely carinate, and a little alate, especially above." ² It is quite evident from a comparison of the two descriptions and an examination of specimens labeled "*P. lonchites*" by Tuckerman that he was dealing with two separate and distinct species. Plants in the Gray Herbarium which, though not fruiting, otherwise fit his original description perfectly and are labelled "*Potamog. lonchites*" in Tuckerman's hand, have no close relationship to the plants associated with that name by Robbins, Morong and, following them, some other American authors, but are flowing-water forms of *P. gramineus* var. *maximus*. Tuckerman's supplementary description was based on *P. nodosus*, which he mistook to be a state of his *P. lonchites*, as a specimen in the Gray Herbarium clearly shows.

P. rotundatus was based by Hagström on four specimens: one each from Nebraska, California, New Mexico and Mexico. Although referring it to the subsection *Amplifolii*, he states: "I have scarcely met with a species corresponding so nearly to *P. nodosus* as regards the stem-anatomy as this. It differs by the smooth leaf margin, the long lower petioles, the prasinous leaf-colour, the ligules, the styles, and chiefly by the characteristic fruits." ³ In the Gray Herbarium are specimens from three of the collections cited. All lack true submersed leaves. The

¹ Edward Tuckerman, Am. Journ. Sci. ser. 2: 6: 226 (1848).

² Edward Tuckerman, Am. Journ. Sci. ser. 2: 7: 351 (1849).

³ J. O. Hagström, Crit. Res. Pot. 154 (1916).

Nebraska plant (*Rydberg*, no. 1421) has no fruit; the specimen from New Mexico (*Fendler*, year 1847) has fruit which is definitely keeled. The Mexican collection (*Pringle*, no. 1390) alone has the fruits as described by Hagström. That they lack keels is true enough, but that they are quite immature is also evident. Numerous specimens of *P. nodosus* show immature spikes the fruits of which vary greatly in the development of keels. As to the leaf-margin, the denticles on the submersed leaves of *P. nodosus* are so extremely fugacious that they are seldom found in any but the youngest leaves. Young leaves of plants approaching the appearance of *P. rotundatus* have denticles as freely as those of typical *P. nodosus*. The stipules ("ligules") of typical *P. nodosus* are often scarcely if at all keeled, so that the lack of keels on those of *P. rotundatus* is not sufficient for its separation.

The species proposed by Hagström as *P. insulanus* is based on a single specimen from Puerto Rico: *Sintensis*, no. 2537, in the herbarium at Stockholm. Originally identified as *P. pensylvanicus* Willd. (*P. epihydrus* Raf.) by Bennett, this collection (at least the specimen in the Berlin herbarium) became, with *Sintensis*, no. 1025, the type material upon which *P. Nuttallii* var. *portoricensis* Graebner was based. Hagström refers *Sintensis*, no. 1025 to *P. nodosus*, though saying, "dubious . . . probably . . . what I call *P. insulanus*." The two numbers before me show clearly that neither has any affinity to *P. epihydrus* (*P. pensylvanicus* or *P. Nuttallii*), as has already been pointed out by Fernald.¹ The number 1025 is rather definitely *P. nodosus*. The number 2537 in the Gray Herbarium is sterile and with small abnormally developed submersed leaves. It appears to be either an ecological form of *P. nodosus* or possibly a hybrid between *P. nodosus* and some member of the subsection *Lucentes*.

Just what *P. mexicanus* Ar. Benn. is cannot be definitely determined. Bennett's description agrees rather well with *P. nodosus*, except: "Fruit 3/16 in. long by 1/4 in. broad." However, fruits seen by Morong were described by him as being "2 lines long, 1½ lines wide,"² less than half as wide, so it can be concluded that Bennett's "1/4 in." is in error. Graebner, who evidently found it convenient to compute his measurements from

¹ M. L. Fernald, Mem. Am. Acad. Arts & Sci. 17: pt. 1: 119 (1932).

² Thomas Morong, Mem. Torr. Club 3: no. 2: 23 (1893).

Bennett's description, gives "5 mm longi et 6 mm lati."¹ Specimens in the Gray Herbarium and cited by Graebner are sterile, but referable to *P. nodosus*.

P. occidentalis, described by Chamisso and Schlechtendal and credited to Sieber, appears, from the description and excellent illustration of the fruit, to be typical *P. nodosus*.

Just what *P. plantagineus* var. *jamaicensis* Grisebach represents is not determined. From the description and judging from the plants found in Jamaica, it appears to be *P. nodosus*. Further study is needed on the subsection *Nodosi* of Central America and the West Indies.

7. *P. NATANS* Linnaeus

RHIZOMES white with reddish spots when fresh, buff with dark red spots when dry (these spots often with lighter centers). **STEM** simple or rarely branched, terete, .8–2 mm. in diameter, with transverse ridges (these also on the rhizome and submersed leaves); stele with the trio-type pattern, the phloem on the inner face of the trio bundle appearing as 2 distinct patches; endodermis well developed, of U-cells; interlacunar and subepidermal bundles present; pseudo-hypodermis 1 cell thick. **SUBMERSED LEAVES** coriaceous, semi-terete, narrowly linear (excluding transition leaves), no differentiation between blade and petiole, tapering at the apex to an obtuse tip, 10–20 cm. long, .8–2 mm. wide; nerves 3–5, obscure. **FLOATING LEAVES** coriaceous, with long petioles 1–2.5 mm. thick, each having a brownish curved joint-like portion at its junction with the blade; blades ovate to oblong-ovate (sometimes ovate-elliptic), cordate to rounded or rarely tapering at base, apex rounded or with an obtuse mucro, 4–9 (–12) cm. long, 2.5–6 (–6.5) cm. wide; nerves (13–) 23–37, with about one-third of them prominent; lacunae none or obscure. **STIPULES** of submersed leaves clasping the stem, whitish, fibrous, persistent, linear to lanceolate, cucullate at apex in the bud, splitting on maturity and becoming raggedly obtuse, or twisting and becoming acutish, 4.5–9 (–11) cm. long, about 5 mm. wide at base, with 2 well-developed keels and many fine nerves; those of the floating leaves similar but usually broader (up to 12 mm. wide at base). **PEDUNCLES** as thick as or slightly thicker than the stem, 3–8 cm. long. **SPIKES** in anthesis compact, with 8–14 whorls; in fruit 3–5 cm. long, .9–1.2 cm. thick. **FLOWERS** sessile or nearly so; sepaloid connectives greenish, reniform to orbicular, (1.6–) 1.8–2.2 (–2.8) mm. wide; anthers about 1 mm. long. **FRUITS** obovoid, (3–) 3.5–5 mm. long, 2.5–3.5 mm. wide; keels none or rounded or with dorsal keel some-

¹ P. Graebner, in Engler, Pflanzenr. 4: fam. 11: 57 (1907).

what prominent if dried before fully mature; beak short and broad; exocarp sack-like, wrinkled, bright orange drying to buff (greenish when immature); endocarp more or less pitted on each side, and with 2 longitudinal sinuses on the back forming 3 rounded keels, beak linear, about 1 mm. long, loop solid; apex of seed pointing toward the basal end. Plants mostly with strongly developed cordate floating leaves and with the narrowly linear submersed leaves decaying early.

P. natans L., Sp. Pl. **1**: 126 (1753); Morong, Bull. Torr. Club, **13**: 145 (1886), Mem. Torr. Club **3**: no. 2: 13 (1893); Graebn. in Engler, Pflanzenr. **4**: fam. 11: 42 (1907); Taylor, N. Am. Fl. **17**: pt. 1: 16 (1909); Hagstr., Crit. Res. Pot. 191 (1916). *P. natans* var. *prolixus*, sensu Am. authors; an Koch?

A common species of lakes and streams, Newfoundland, south to Pennsylvania, west to California, and north to southern Alaska. MAP 8. Eurasia. The following, selected from a large series of specimens are representative: NEWFOUNDLAND: Bishop Falls, Valley of Exploits R., *Fernald, Wiegand & Darlington 4461*; Highlands P., Crabbes, *Kennedy 80*; 4 miles northeast of Port à Port, *Mackenzie & Griscom 10043*. QUEBEC: Mingan Islands, Saguenay Co., *St. John 90081*; Maria, Bonaventure Co., *Victorin, Rolland & Jacques 33316*; marly pond, Grand R., Gaspé Co., *Collins, Fernald & Pease 5295*; Lac Porc-Épic, Saint-Fabien, *Rousseau 30003*; Black L., Megantic Co., *Fernald & Jackson 11986*; Lac Tremblant, Labelle Co., *Victorin & Rolland 44070*; Lake Memphremagog, Sargent's Bay, Aug. 1, 1903, *J. R. Churchill*; Ile Verte, Longueuil, Chambly Co., *Rolland 43363*; McGregor L., *John Macoun 85530*; North Wakefield, *J. M. Macoun 4358*. MAGDALEN ISLANDS: between E. Cape & E. Point, Coffin Island, *Fernald, Long, & St. John 6763*. PRINCE EDWARD ISLAND: east of Britain P., Kings Co., *Fernald & St. John 10894*. NOVA SCOTIA: Pottle's L., North Sydney, Cape Breton Co., *Bissell & Linder, 19678*; west of Ingonish, Cape Breton Island, *Nichols 749*; Salmon R., Truro, Colchester Co., *Bean & White 19675*; Middleton, Annapolis Co., *Fernald & Pease 19676*; Wentworth L., Digby Co., *Fernald & Long 23130*; St. John (Wilson's) L., Yarmouth Co., *Fernald, Bartram & Long 23129*; Charcoal, valley of the East R., *St. John 1372*. MAINE: Portage L., Aroostook Co., 1881, *Kate Furbish*; Great Works Stream, Clifton, Penobscot Co., *Fernald 2756*; Foxcroft, Piscataquis Co., *Fernald 475*; Baker L., T 7 R 17, Somerset Co., *St. John & Nichols 2106*; Swan P., Oxford Co., July 1892, *J. C. Parlin*; Torrey P., Deer Isle, Hancock Co., *A. F. Hill 2560a*; Stevens P., Liberty, Waldo Co., *Rosbach 60*; Black Duck P., Matinicus, Knox Co., July 13, 1919, *C. A. E. Long*; Sydney, Kennebec Co., *Fernald & Long 12381*; n. of Perley P., Sebago, Cumberland Co., *Fernald, Long & Norton 12382*; Wells, York Co.,

July 1881, *J. Blake*. NEW HAMPSHIRE: Cherry P., Jefferson, Coös Co., *Pease 20073*; Long (Stacy) P., Washington, Sullivan Co., *Fernald & Svenson 745*; Frost P., Jaffrey, Cheshire Co., *B. L. Robinson 494*; Derry, Rockingham Co., Aug. 3, 1926, *C. F. Batchelder*; West Lebanon, Sept. 7, 1891, *G. G. Kennedy*; Bellamy R., Madbury, Strafford Co., *Hodgdon 2640*. VERMONT: Pelot's Bay, Lake Champlain, North Hero, Grand Isle Co., Aug. 2, 1899, *Nellie Flynn*; West Barnet, Caledonia Co., Aug. 20, 1884, *F. Blanchard*; Lowell L., Londonderry, Windham Co., *L. A. Wheeler*; Dead Creek, Ferrisburg, Aug. 15, 1881, *E. Faxon*. MASSACHUSETTS: Long P., Tewksbury, Middlesex Co., Aug. 24, 1865, herb. *Boott*, also *L. B. Smith 632*; Lower P., Wakefield, Middlesex Co., *Collins 937*; Plymouth, Plymouth Co., Aug. 26, 1913, *S. N. F. Sanford*; Eastham, Barnstable Co., *Collins 3171*; Sutton, Worcester Co., *Anderson, Smith & Weatherby 1166*; Robinson Creek, Pembroke, *Fernald & Svenson, Gray Exsic. 409*; Lake Buel, New Marlboro, Berkshire Co., July 20, 1920, *J. R. Churchill*. RHODE ISLAND: Providence, July 1866, *G. Thurber*. CONNECTICUT: Twin Lakes, Salisbury, Litchfield Co., *Eames & Godfrey 8679*; Dog P., Goshen, Litchfield, Aug. 24, 1913, *Bissell & Weatherby*; Farmington R., Hartland, Hartford Co., *Ogden & Bolan 1565*; Long P., Thompson, Windham Co., *Weatherby 4364*; Mahoney Meadow, Franklin, New London Co., July 27, 1905, *R. W. Woodward*. NEW YORK: Pierrepont P., Woodville, Jefferson Co., *House 16979*; Lake Canandaigua, Woodville, Aug. 19, 1884, *Morong*; Spencer L., Spencer, Tioga Co., *E. Moore 1488*; Tioughneoga R., Riverside Park, Cortland Co., *E. L. Palmer 37*; Carpenters P., Fabius, Onondaga Co., *House 1338*; Sodus Bay, Wayne Co., *Killip 6204 & 12258*. NEW JERSEY: Black R., Chester, Morris Co., *Mackenzie 4377*; Swartswood L., Sussex Co., *Griscom & Mackenzie 10685*. ONTARIO: Ko-Ko-Ko Bay, L. Timagami, *Cain 1045*; Franks Bay, Lake Nipissing, *Chitty 260*; McKay's L., near Ottawa, *Malte 118270*; McGregor Bay, Manitoulin Dist., *Ogden & Bolan 1646*; Cypress Lake Channel, Tobermory, Bruce Co., *Krotkov 7038*; Little Eagle Harbor, Lake Huron, *John Macoun 26840*; Golden L., Renfrew Co., July 28, 1899, *L. M. Umbach*; Dumbell L., Pancake Pt., Algoma Dist., *Taylor, et al. 295*. MICHIGAN: Isle Royale, *Cooper 260*; St. Ignace, Mackinac Co., *Pease & Ogden 24165*; Lake Charlevoix, Ironton, Charlevoix Co., *Ogden & Bolan 1676*; Bessey Creek, Cheboygan Co., *Gates 12217*; Manistee, Aug. 8, 1882, *Morong*; Pine L. near Mich. Ag. Coll., July 25, 1891, *C. F. Wheeler 7*; Thread P., Flint, Aug. 11, 1909, *Sherff*; Kimble L., Vicksburg, Kalamazoo Co., July 3, 1938, *Rapp 2238*; Barton L., Kalamazoo Co., *Hanes 1978*; Park L., Ingham Co., July 22, 1926, *Oosting*. OHIO: Buckeye L., e. of Columbus, *Morris A41*; Put-in-Bay, Aug. 1898, *A. J. Pieters*. INDIANA: Wolf L., *Agnes*

Chase 1459; Wolf L., Lake Co., *Lansing 4274*; Bear L., Noble Co., *Deam 49391*; Cheeseborough L., Flint, Steuben Co., *Deam 49360*; Lake Maxinkuckee, *Evermann 1032* (US), also *Scovell & Clark 1032* (271), under direction of *Evermann* (F), also *Scovell 26* (US, mixed with *P. amplifolius*). WISCONSIN: Elkhart L., Aug. 28, 1887 and Aug. 4, 1892, *F. H. Schuette*; Pell L., Bloomfield Twp., Walworth Co., *Hotchkiss & Koehler 4193*; Lauderdale, *Bebb 995 & 1008*; Valley of the Wisconsin R., near Rainbow Rapids, *Cheney 1420*. ILLINOIS: Lake Villa, Lake Co., *Gleason & Shobe 179*; Grass L., Lake Co., *Gates 1752.2*; Cedar L., 50 mi. n. of Chicago, *Roush 812*; Ringwood, *Geo. Vasey*. MINNESOTA: Lake Itasca, Clearwater Co., *Grant & Oosting 3203*; Cass L., *Pammel 100*; Minnesota R., Dakota Co., June 1895, *E. P. Sheldon*; Great Crab L., St. Louis Co., Sept. 3, 1919, *Butters*; Green L., Chisago City, *Metcalf 1295*; Swan L., Nicollet Co., *Metcalf 50*; Schultz L., Kandiyohi Co., *Metcalf 2113*; Koronis L., Stearns Co., *Metcalf 1388*, also *Kubichek 115b* (US, mixed with *P. amplifolius*); Little Pine L., Aitkin Co., *Over 17139*; Lizzie L., Ottertail Co., *Kubichek 190*; Bear L., Freeborn Co., *Shunk & Manning 83*; German L., Le Sueur Co., *Shunk & Manning 225*; Lake Charlotte, Wright Co., *Linsdale & Keck 127*; Silver L., Mille Lacs Co., Aug. 1892, *E. P. Sheldon*. IOWA: Spirit L., Dickinson Co., July 31, 1896, *B. Shimek*, also July 29, 1897, *R. I. Cratty*; Round L., Lake Twp., Clay Co., *Hayden 823*. NORTH DAKOTA: Upsilon L., Turtle Mts., St. John, Rolette Co., *Mabbott 459*; Metigoshe L., Turtle Mts., Bottineau Co., *Metcalf 544*. NEBRASKA: Hannah's L., Cherry Co., *Smith & Pound 228*; Hackberry L., Cherry Co., July 20, 1912, *Pool & Folsom*, also *Tolstead 638*; Niobrara Game Reserve, near Valentine, *Tolstead 428*; Swan L., Grant Co., *Rydberg 1652*; Shafer L., Garden Co., *Uhler & Martin 1660*; South Cody L., *Ray Thomson 232*. ALBERTA: n. of Lake Louise, Rocky Mts., *Macoun 68425* (C). MONTANA: Lake McDowell, Glacier Nat'l Park, *Maguire & Piranian 5439*; Avalanche L., Glacier Nat'l Park, *Standley 18500*; Rost L., Big Fork, *Whitford 254*, also *MacDougal 676*; Whitefish L., Aug. 24, 1892, *R. S. Williams*. IDAHO: Lake Pend Oreille, near Hope, *Sandberg, MacDougal & Heller 939*; Lake Pend Oreille, Aug. 1891, *J. B. Leiberg*; valley of Lake Tesemini, Kootenai Co., *Sandberg, MacDougal & Heller 697*; Paradise Creek, Moscow, *Henderson 2717*; Priest L., *Piper 3765*, also *MacDougal 240*; Potlatch R., Nez Perce Co., *St. John et al. 9740*; Warm L., 25 mi. n. e. of Cascade, Valley Co., *Rollins & Chambers 2590*; Fernan L., Coeur d'Alene, *Rust 385*. WYOMING: Jackson's Hole, Lincoln Co., *E. B. & Lois B. Payson 2251*; Grand Encampment, *Aven Nelson 4145*. COLORADO: Laramie R., Larimer Co., Aug. 4, 1891, *C. S. Crandall* (NY); Crested Butte, Aug. 1891, *Cal. Acad. Sci. Herb.* (S). UTAH: Weber R., *Sereno Watson 1131* (G, see also next citation). NEVADA: Ruby

L., *Sereno Watson 1131* (G, NY, US, see also previous citation). NEW MEXICO: Long L., Chusca Mts., San Juan Co., *A. Wetmore 541* (US). ARIZONA: Marsh L., White Mts., *Goldman 2453* (US); Walker L., San Francisco Mts., *Knowlton 288* (US). CALIFORNIA: Fletcher Creek at Pease Place, Devil's Garden, Modoc Co., *L. C. Wheeler 3973*; near Lassen Buttes, Plumas Co., *H. E. Brown 644*; Upper Mud L., Coal Mine Ridge, San Mateo Co., *R. S. Ferris 2043*; Mather, Tuolumne Co., *Keck 1188*; Lakeside, Eldorado Co., June, July 1912, *H. D. Geis*; Lily L., near Fallen Leaf, Lake Tahoe region, Eldorado Co., *Wiggins 6757, 6777 & 6797*; Big Lagoon, Big R., Mendocino Co., *McMurphy 193*; Bear Valley, San Bernardino Mts., *S. B. & W. F. Parish 1435*. OREGON: Salem, *Elihu Hall 486*; Sauvie's Island, Willamette, Multnomah Co., *Howell 365*; Seven Mile Creek, Klamath L., Klamath Co., *Applegate 4489*; w. fork of Illinois R., near Floyd School, Josephine Co., *Abrams 8677*; Port Orford, *Peck 8514*; Quartz Valley, *Coville & Leiberg 224 & 228*; Cape Arago, Coos Co., *House 5044*. WASHINGTON: first pond east of summit, Nespelem road, Okanogan Co., *Fiker 1455*; Oyhut, Chehalis Co., *Lamb 1259*; Nooksack R., Lummin Indian Reservation, Whatcom Co., *Muenschler 7643*; Seattle, *Piper 758*. BRITISH COLUMBIA: Revelstoke, *John Macoun 3019*; Colquitz R., near Victoria, *John Macoun 88248*; San Juan L., Dist. of Renfrew, *Rosendahl 790*; Chilliwack Valley, *J. M. Macoun 26814*; Griffin L., *Macoun 2971* (C, mixed with *P. epihydrus* v. *Nuttallii*), also *Macoun 3020*. ALASKA: Prince of Wales Island, Klawak L., *Mr. & Mrs. E. P. Walker 994*; Ketchikan, *Cowles 1405*; Dundas Bay, *J. P. Anderson 1344*; Sitka, *J. P. Anderson 21*, also *Evans 781*.

P. natans is a familiar species over all the northern half of the United States. Because of its wide range and tendency to fruit freely it is one of the primary foods for wild water-fowl.

Although the American plant seldom attains the robustness so typical of the European plant, there seem to be no characters fundamental enough to separate the two, even as varieties. The fruit of the American plant has a weaker endocarp-beak than that of the European, a fact noted for the American *P. alpinus*, but unlike the case of that plant, the drying of the mesocarp of *P. natans* does not cause any appreciable difference in the shape of the fruits on the two hemispheres. The endocarp loop is invariably solid in the American plant and sometimes shows a cavity in European specimens.

P. natans, like the other broad-leaved species, responds markedly to ecological conditions. Many of these forms have been given names. In fact, some of the names on the labels for

the European plants make habitat-notes quite superfluous. When in quiet water, the floating leaf-blades become broad and definitely cordate; when in a current, the blades are narrower and rounded or cuneate at the base. Flowing water also causes an elongation of the internodes and a marked reduction in the production of inflorescences.

An aquarium plant of *P. natans*, which grew from a seed in my laboratory, showed an interesting sequence of development. The first shoot produced only the linear submersed leaves; the second shoot produced some broad leaves, which were much narrower than normal and narrowly cuneate at base; the third shoot produced the typical broad floating leaves which were cordate at base. Then a number of shoots were sent up at about the same time, the floating leaf-blades of which, however, reverted to the narrow type with cuneate bases. Finally, the branching rhizome sent up numerous shoots, all of which produced submersed leaves only, or a few leaves with slightly dilated tips. Thus from one seed were produced forma *submersus* Glück, var. *prolixus* Koch, and var. *vulgaris* Koch & Ziz (var. *typicus*). The aquarium was not so constructed that var. *terrestris* S. F. Gray might appear.

An interesting form of *P. natans* which grew in the tidal water of Robinson Creek, Pembroke, Massachusetts, has been observed on several occasions by Prof. Fernald, and as it appeared to remain the same, was collected by Fernald and Svenson and distributed from the Gray Herbarium. With its reduced floating leaf-blades, narrowly cuneate at base, on long petioles, and its production of winter buds (collected in October), this is obviously an ecological state. Mr. Weatherby kindly drove me to the locality, but so many changes, attendant on the building of a paved road and a new bridge, have so altered the locality as described by Prof. Fernald that no *P. natans* was found. In such a habitat, where the tidal water rises and lowers twice a day and perhaps at times becomes slightly brackish, no fresh-water species of *Potamogeton* can be expected to lead a normal life. That the floating leaves of this plant were submersed at times is evidenced by the non-functional and reduced number of stomates.

Fryer's remarks on "some beautiful seedling forms of *P.*

natans, with lanceolate, oval, and round floating leaves, sufficient to afford examples of several named 'varieties', but unfortunately all growing on *one rootstock* in the instance in which the 'varieties' were most marked!" are of interest here.

American plants labeled "var. *prolixus*" include juvenile and elongated forms of *P. natans* and elongated forms of *P. Oakesianus*. They are always sterile.

8. *P. OAKESIANUS* Robbins

RHIZOMES whitish with red spots. STEM often branched, terete, .5–1 mm. in diameter; stele with the trio-type pattern, the phloem on the inner face of the trio-bundle appearing as 2 patches; endodermis well developed, of U-cells; interlacunar and subepidermal bundles present; pseudohypodermis absent or 1 cell thick. SUBMERSED LEAVES delicate, narrowly linear, obtuse, 5–16 cm. long, (.25–) .3–1 mm. wide; nerves 3. FLOATING LEAVES coriaceous, with long petioles .2–1 mm. thick; blades ovate-elliptical to oblong-elliptical, rounded or tapering at base, obtuse, (1.5–) 2–4 (–5.5) cm. long, 1–2 (–3) cm. wide; nerves (7–) 9–19 (–23), about one-third of them prominent; lacunae none or obscure. STIPULES of the submersed leaves clasping the stem, whitish, delicately fibrous, persistent but becoming shreddy, linear, acutish when dry, about 1–3 cm. long; those of the floating leaves larger, 2–4 (–5.5) cm. long, linear or narrowly triangular, strongly fibrous, 2-keeled, at least at base. PEDUNCLES thicker than the stem, .9–1.6 mm. in diameter, 2.5–6 cm. long. SPIKES with 3–8 whorls; in fruit 1–3.5 cm. long, .7–.9 cm. thick. FLOWERS sessile or nearly so; sepaloid connectives 1.3–1.8 (–2.2) mm. wide; anthers about .8 mm. long. FRUITS obovoid, 2.5–3.5 (3.7) mm. long, (1.6) 2–2.4 mm. wide; lateral keels rounded, dorsal keel usually prominent and acutish; beak short and broad; exocarp smooth or nearly so, greenish or rarely buff; endocarp with smooth sides, and with 2 rather deep sinuses on the back forming 3 obtuse keels, beak linear, about .8 mm. long, loop solid; apex of seed pointing a little above the basal end. Plants similar to *P. natans* but smaller.

P. Oakesianus Robbins in Gray, Man. Bot. ed. 5: 485 (1867); Morong, Mem. Torr. Club 3: no. 2: 14 (1893); Taylor, N. Am. Fl. 17: pt. 1: 16 (1909); Hagström, Crit. Res. Pot. 196 (1916). *P. Purshii* Tuckerm. sensu Graebn. in Engler, Pflanzenr. 4: fam. 11: 45 (1907); ? Tuckerm., Amer. Journ. Sci. ser. 2: 6: 228 (1848), see Fernald, Mem. Am. Acad. Arts & Sci. 17: pt. 1: 121 & 122 (1932).

Shallow pools and edges of quiet ponds, Newfoundland, Anticosti, Magdalen Islands, Nova Scotia, eastern New Brunswick,

Maine, south to New Jersey, west to central New York, and local in Michigan, Wisconsin, and western Ontario. MAP 9. NEWFOUNDLAND: Quirpon Island, Straits of Belle Isle, *Wiegand, Gilbert & Hotchkiss 27339*; Grand Falls, *Fernald, Wiegand & Darlington 4464 & 4465*; Blomidon ("Blow-me-Down") Mts., *Fernald & Wiegand 2436*; Lookout Mt., Bonne Bay, *Fernald, Long & Fogg 1208*; McCleman's P., Crabbes, *R. B. Kennedy 543*; Port aux Basques, *Fernald, Long & Dunbar 26217*. QUEBEC: Les Trois Lacs, Laurentides, *Victorin, Rolland & Jacques 33639*; Rivière Noire, Portneuf Co., *Rousseau 25814*; Matamek R. Dist., North Shore, *Bowman 392*. ANTICOSTI: Ellis Bay, *Macoun 2993*. MAGDALEN ISLANDS: Coffin Island, *Fernald, Long & St. John 6764 & 6765*; Cap-de-l'Est, Ile de la Grande-Entrée, *Victorin & Rolland 9922*. NEW BRUNSWICK: Lac Fox Creek, Westmorland Co., *Victorin, Rolland & Jacques 44749*; Lily P., Southern Head, Grand Manan, Charlotte Co., *Knowlton & Weatherby 6632*. NOVA SCOTIA: Taylor's L., Sunny Brae, Pictou Co., *St. John 1373*; Clyde R., Shelbourne Co., *Prince & Atwood 1318 (S)*; Goose L., Argyle, Yarmouth Co., *Fernald & White 19680*; Petpeswick, Musquodoboit Harbour, Halifax Co., *Rousseau 35293*; Five-Island L., Hants Co., *Fernald, Bartram & Long 23131*; Lena L., St. Paul Island, *Perry & Roscoe 38*. MAINE: Haley P., Rangeley, Franklin Co., Sept. 1, 1894, *Furbish*; Gilead, Oxford Co., 1897, *Furbish*; Jordan P., Hancock Co., Sept. 10, 1898, *E. L. Rand*; Hackmatack Swamp, Isle au Haut, Knox Co., *A. F. Hill 1222*; Southport, Lincoln Co., *Fassett 18803*; Perley P., Sebago, Cumberland Co., *Fernald, Long & Norton 12384*; Lily P., East Limington, Limington, York Co., *Fernald, Long & Norton 12383*. NEW HAMPSHIRE: Connecticut R., Northumberland, Coös Co., *Pease 12171*; Wheeler P., Shelbourne, Coös Co., Aug. 31, 1918, *Deane*; Merrimack, Hillsboro Co., June 19, 1918, *Batchelder*; Stonehouse P., Barrington, Strafford Co., *Hodgdon 599*. VERMONT: Grout P., Stratton, Windham Co., *Eggleston 2111*; also Sept. 1, 1931, *R. J. Eaton*. MASSACHUSETTS: So. Natick, Middlesex Co., Sept. 15, 1881, *Morong*; Wellesley, Norfolk Co., July 20, 1908, *Wiegand*; Plymouth, Plymouth Co., June 24, 1895, *J. W. Blankinship*; Wellfleet, Barnstable Co., *Fernald & Fogg 505*; pond between Lizzie's P. and Goose P., Chatham, Barnstable Co., *Fernald 15955*; Edgartown, Dukes Co., *Seymour 1487*; Nantucket, Nantucket Co., 1886, *L. L. Dame*; Uxbridge, Worcester Co., Aug. 28, 1851, (TYPE in herb. N. Y. Bot. Gard., cotypes in F, G, NE) and Aug. 18, 1870, *Robbins*, also June 5, 9, & 24, 1876, *Morong*; Lake Chaubunagungamaug, Webster, Worcester Co., *Ogden & Bolan 1562*; Spectacle P., Sandisfield, Berkshire Co., June 29, 1912, *R. Hoffmann*. CONNECTICUT: Middlebury, New Haven Co., Sept. 14, 1901, *Harger*; Stafford, Aug. 1897, herb. *E. L. Morris*. NEW

YORK: Quiver P., Fourth L., Fulton Chain, Adirondack Mts., Killip 12574 (US, mixed with *P. epiphydrus* v. *Nuttallii*, G, not mixed); Brandy Brook Flow, Cranberry L., St. Lawrence Co., Muenscher & Maguire 1711; Big Moose L., Herkimer Co., Muenscher & Maguire 1716; Fall Creek, Tompkins Co., Dudley; Deep P., Wading R., Long Island, E. S. Miller; Rock P., Adirondacks, Aug. 5, 1884, Morong; McDonough, July 26, 1886, F. V. Coville. NEW JERSEY: Pump Branch of Albertson Brook, Ancora, Camden Co., J. W. Adams 511; Magnolia L., Ocean View, Cape May Co., Sept. 29, 1921, H. B. Meredith; Estellville, Atlantic Co., July 4, 1883, C. A. Gross. ONTARIO: Sand Pt., Algoma Dist., Lat. 47° 00' N., Long. 84° 45' W., Taylor et al. 297 (C). MICHIGAN: bog near Rock R., Alger Co., Fernald & Pease 3066; Au Train, Alger Co., Pease & Ogden 25135; Crooked L., Clyde Twp., Allegan Co., Aug. 18, 1937, D. L. Allen; Crooked L. Marsh, Allegan Co., Aug. 4, 1938, W. G. Erwin; ½ mi. s. w. of West L., Portage Twp., Kalamazoo Co., Hanes 407. WISCONSIN: Potter's Cranberry Farm, Cutler, Juneau Co., Sept. 23, 1932, J. H. Steenis (G); Valley of the Wisconsin R., near Grand Rapids, Cheney 3610 (NY).

P. Oakesianus has the general appearance of *P. natans* except that it is uniformly smaller in all its parts. There are fundamental differences, however, chiefly in regard to the fruit. The fruit, besides being smaller, lacks the puckered, buff epicarp of *P. natans* and is, instead, stretched and smooth and usually green. The fruits also differ from those of *P. natans* by having 3 prominent keels. The other differences are mainly those correlated with size. While the submersed leaves of *P. natans* are generally borne on the single main stem, those of *P. Oakesianus* are on branches.

9. *P. GRAMINEUS* Linnaeus (American varieties)

RHIZOME buff, often suffused or spotted with red, variable in thickness. STEM much branched, terete .5–1 mm. in diameter; stele with the oblong-type pattern with but 1 central bundle (rarely with 2) and usually but 1 lateral bundle on each side; endodermis of U-cells strongly thickened on the inner and lateral faces; interlacunar bundles strongly developed but only in the outer interlacunar circle; subepidermal bundles present or absent; pseudo-hypodermis absent or 1 cell thick. SUBMERSED LEAVES linear to linear-lanceolate or lance-elliptical (sometimes oblanceolate), 1–9 (–13) cm. long, (.1–) .2–1 (–1.5) cm. wide, tapering gradually to a sessile base; apex acute, usually sharp-pointed; nerves 3–9 (–11); lacunae of 1 or 2 rows along

midrib, mostly obscure; margins with fugacious 1-celled translucent denticles. FLOATING LEAVES coriaceous, blades ovate to elliptical (rarely subrotund), 1.5–5 (–7) cm. long, 1–2 (–3) cm. wide; apex obtuse or bluntly mucronate; base cuneate or rounded; petioles 2–10 (–15) cm. long, mostly longer than the blades; nerves 13–17 (–23); lacunae obscure. STIPULES persistent, obtuse and slightly cucullate at apex, those of the submersed leaves and branches .5–3 cm. long, 1–2 mm. wide at base, faintly 2-keeled, with 8 to 30 finer nerves, those of the floating leaves broader. PEDUNCLES at base about same thickness as stem, sometimes clavate, 2–10 (–30) cm. long. SPIKES in anthesis usually rather compact, of 5–10 whorls of flowers; in fruit cylindric and crowded, 1–2.5 cm. long, .6–.8 cm. thick. FLOWERS sessile or on pedicels up to .5 mm. long; sepaloid connectives orbicular to oval, blades (.7–) 1.2–1.6 (–2.3) mm. wide, claws (.2–) .4–.8 (–1) mm. long; anthers oblong .6–1 (–1.1) mm. long. FRUITS mostly obovate, 1.7–2.5 (–2.8) mm. long (excluding beak), (1.4–) 1.6–2 (–2.3) mm. wide, keels usually strongly evident, but often obscured by the loose exocarp, beak facial, short and curved toward the back; exocarp usually loose, green or rarely tawny; endocarp with keels low and obtuse, beak linear, weak, .3–.5 mm. long, loop solid; apex of seed pointing .3–.7 mm. above the basal end. A variable species characterized by a stem with many lateral compound branches bearing numerous small leaves. Among the many variants of *P. gramineus*, the following seem worthy of recognition:

1. Principal submersed leaves narrowly elliptic to oblanceolate, (1–) 1.5–9 (–13) cm. long, .2–1 (–1.5) cm. wide, 5–10 times as long as broad, or if more than 10 times, then not less than 6 cm. long, sides not parallel; nerves (3–) 5–9.
2. Principal submersed leaves (1–) 1.5–4.5 (–6.5) cm. long, .2–.6 (–.8) cm. wide; nerves 5–7. 9a. var. *typicus*.
2. Principal submersed leaves (3–) 6–9 (–13) cm. long, .6–1 (–1.5) cm. wide; nerves 7–9 (–11). 9b. var. *maximus*.
1. Principal submersed leaves linear, (1–) 1.5–3.5 (–5.5) cm. long, .1–.25 (–.3) cm. wide, 10–20 (–30) times as long as broad, sides essentially parallel for most of their length, tapering at apex to an acute tip; nerves 3. 9c. var. *myriophyllus*.

9a. *P. GRAMINEUS* L. var. **typicus**

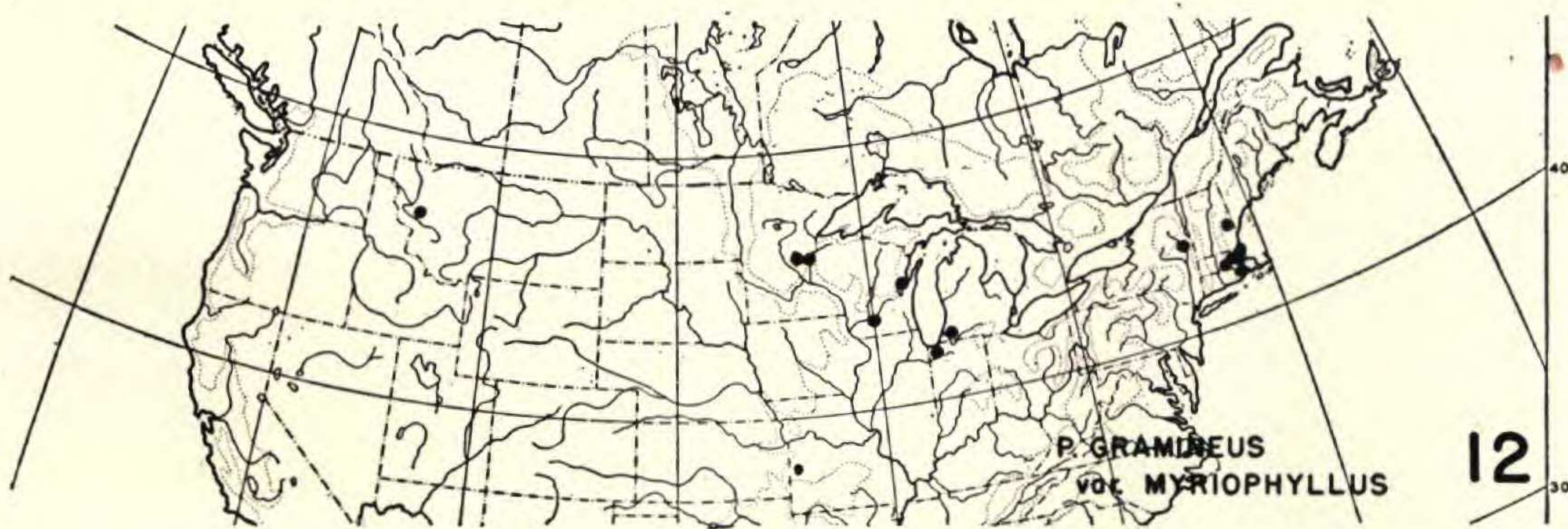
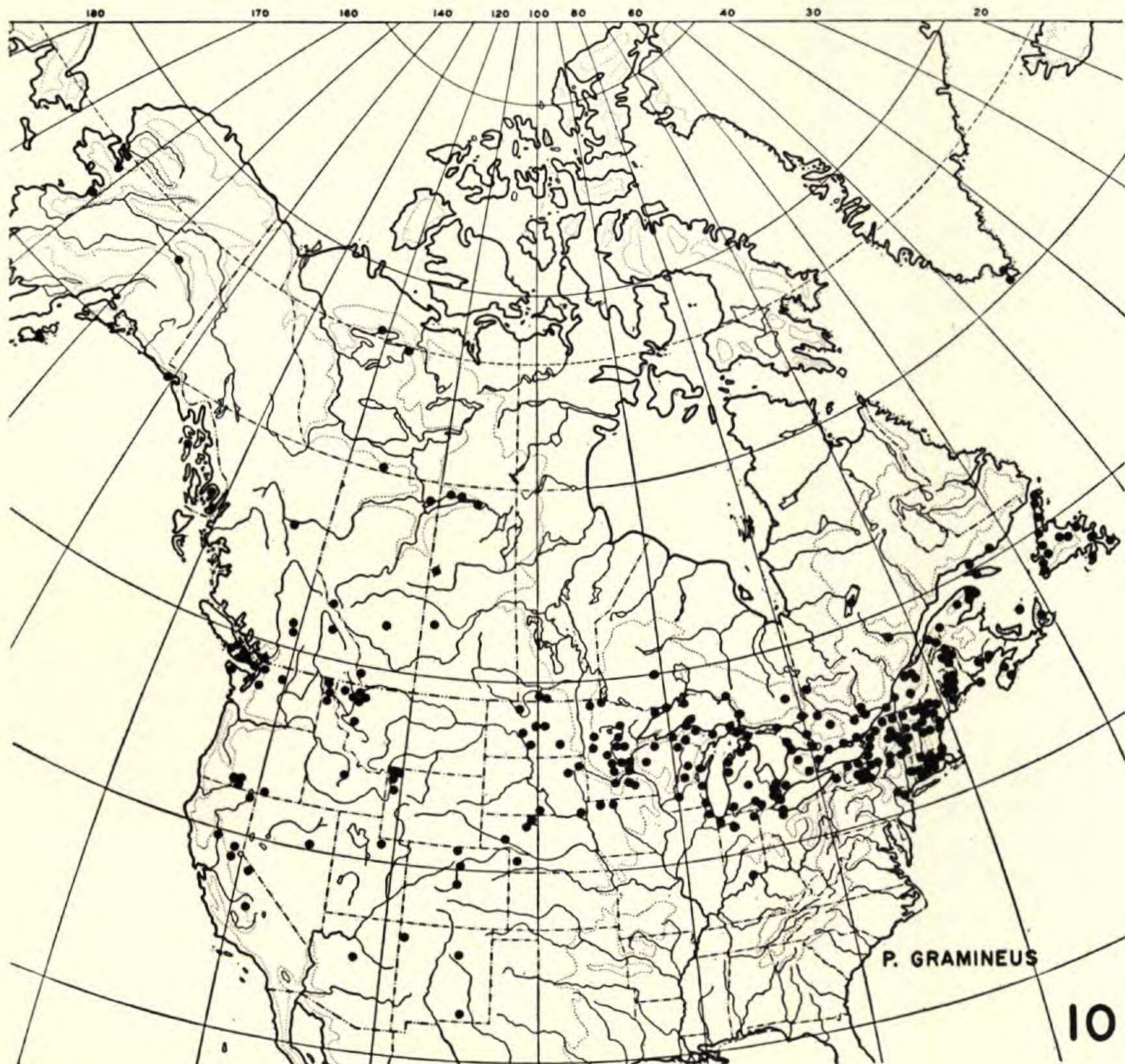
P. gramineus L., Sp. Pl. 1: 127 (1753); Graebn. in Engler, Pflanzenr. 4: fam. 11: 84 (1907). *P. Proteus heterophyllus* C. & S., Linnaea 2: 202 (1827). *P. gramineus* var. *graminifolius* Fries, Novit. Fl. Suecicae 36 (1828), and subsequent Am. authors. *P. heterophyllus* sensu Morong, Mem. Torr. Club 3: no. 2: 23 (1893); Taylor, N. Am. Fl. 17: pt. 1: 19 (1909); not Schreb. *P. heterophyllus* forma *graminifolius* Morong, Mem. Torr. Club 3: no. 2: 24 (1893). *P. heterophyllus* forma *longipedunculatus* Morong,

Mem. Torr. Club **3**: no. 2: 24 (1893), at least in part. *P. gramineus* var. *longipedunculatus* Graebn. in Engler, Pflanzenr. **4**: fam. 11: 88 (1907). *P. heterophyllus* forma *terrestris* Robinson & Fern., Gray's Man., ed. **7**: 74 (1908). *Spirillus heterophyllus* Nieuwl., Am. Mid. Nat. **3**: 17 (1913). *P. gramineus* forma *longipedunculatus* House, Bull. N. Y. State Mus. **254**: 53 (1924), at least in part. *P. gramineus* forma *terrestris* Carpenter, Fl. Vt., 3rd rev. ed.: 25 (1937). *P. gramineus* var. *lacustris* sensu Hultén, Fl. Alaska and Yukon, pt. 1: 100 (1940).

Lakes and streams, southern Greenland to Alaska, south to New Jersey, Ohio, Indiana, Illinois, Iowa, Nebraska, New Mexico, Arizona, and California. MAP 10. Eurasia. Of the very numerous collections of this variety the following are the most typical in the areas cited: GREENLAND: Igaliko, 1828, *J. Vahl*, also July 23, 1888, *Rosenvinge 2990*; Igaliko-Fjord, Qags-siarssuk, Aug. 5, 1925, *A. E. & M. P. Porsild*; Frederiksdal, July 25, 1925, *A. E. & M. P. Porsild*. NEWFOUNDLAND: Bear Cove, Straits of Belle Isle, *Wiegand & Pease 27340*; Flower Cove, Straits of Belle Isle, *Fernald & Long 27345*; Birchy Cove (Curling), *Fernald, Wiegand & Kittredge 2445 & 2447*; Bonne Bay, Main R., *Fernald & Long 1210*; Highlands Brook, Crabbes, *Kennedy 82*. QUEBEC: Lake Mistassini, *Macoun 2980 & 2984*; Trout P., mouth of Grand R., *Collins, Fernald & Pease 4013½, 5287, 5314 & 5314A*; Lotbiniere, Lotbiniere Co., *Victorin, Rolland & Jacques 33714*; New Richmond, Bonaventure Co., *Victorin, Rolland & Jacques 33855*; Lake Temiscouata, *Victorin 526*; Farm Point, Gatineau R., *J. M. Macoun 80929*; Ottawa R. at Gatineau Point, *Malte 118257*; Blue Sea L., *Malte 118265*; Lac Wattopekah, St. Georges de Windsor, Richmond Co., *Louis-Marie, Laporte & Dudemaine 1403*; Black L., Megantic Co., *Fernald & Jackson 11988*. ANTICOSTI: Ruisseau Harvey, Aug. 17, 1917, *Victorin 4195*. MAGDALEN ISLANDS: Amherst Island, *St. John 1758* (toward var. *maximus*). NOVA SCOTIA: Warren L., Cape Breton I., *Nichols 876*; George R., Cape Breton I., *Bissell & Linder 19692*; Little R., Tiddville, Digby Co., *Fernald & Long 19690*. NEW BRUNSWICK: Nerepis R., Westfield, Kings Co., *Fernald 1619*; Hammond R., Hammond, Kings Co., *Svenson & Fassett 3046*; Lake Utopia, *Wetmore 2988*; Little Tobique L., *Hay 2989*. MAINE: Fort Fairfield, Aroostook Co., *G. D. Chamberlain 1770*; Fish River L., Aroostook Co., *Ogden 1716*; Pushaw P., Glenburn, Penobscot Co., *Ogden & Steinmetz 1545*; Indian P., St. Albans, Somerset Co., *E. C. & Edith B. Ogden 2013*; Pitcher P., Northport, Waldo Co., *Ogden & Steinmetz 1612*; Wilson P., Wilton, Franklin Co., *Ogden & Marston 1698*; Presumpscot R., North Windham, July 9, 1899, *W. C. Kendall*. NEW HAMPSHIRE: Dead R., Berlin, Coös Co., *Pease 22754*; Lake Winnipisaukee near Melvin Village, Aug. 15, 1904,

M. A. Day. VERMONT: Little Otter Creek, Lake Champlain, Ferrisburg, Aug. 7, 12, and 20, 1880, *C. E. Faxon*; Queechee Gulf, July 29, 1890, *G. G. Kennedy*; Fairfield P., Fairfield, Franklin Co., *Blake 3071*. MASSACHUSETTS: Mystic L., July 4, 1852, *Robbins*; Fresh P., Cambridge, August 6, 1883, *Morong*; Sandy P., Lincoln, Sept. 15, 1868, herb. *Wm. Boott*; Natick, Aug. 14 and 17, 1883, *Morong*. CONNECTICUT: Selden's Cove, Lyme, Aug. 31, 1900, *C. B. Graves*; Pistapaug P., Durham, *Weatherby 3389*; several collections from Lake Saltonstall, E. Haven are typical *P. gramineus*, others from the same lake approach var. *myriophyllus*, still others approach var. *maximus* or are perhaps *P. gramineus* × *P. illinoensis*. NEW YORK: Butterfield L., Jefferson Co., *Muenschler & Maguire 1690*; Osgood P., Franklin Co., *Muenschler & Maguire 778*; Otsego L., Otsego Co., *Muenschler & Curtis 4880*; Bullhead P., Minerva, Essex Co., *House 15193*; Myers Pt., Ludlowville, Tompkins Co., Aug. 13, 1884, *W. R. Dudley*. NEW JERSEY: Morris P., Sept. 13, 1887, *N. L. Britton*; Morris L., Aug. 10, 1894, herb. *W. M. Van Sickle*; Lake Hopatcong, Morris Co., *C. F. Austin* (C, mixed with *P. gramineus* var. *maximus*; NY, not mixed); Swartzwood L., Sussex Co., *Griscom & Mackenzie 10686*. ONTARIO: Belleville, *Macoun 2985*; Great Opeongo L., Algonquin Park, *Macoun 22216 & 22217*; McGregor Bay, Manitoulin Dist., *Ogden & Bolan 1644 & 1645*; near Dyer Bay, Bruce Pen., *Pease & Ogden 24911*; Gillies L., Bruce Pen., *Cain 938*; Ko-Ko-Ko Bay, Lake Timagami, *Cain 1039 & 1042*. MICHIGAN: Isle Royale, *Cooper 69*; Seneca L., Keweenaw Co., *Hermann 8286*; Brevort L., Moran, Mackinac Co., *Ogden & Bolan 1680*; Lake Charlevoix, Ironton, Charlevoix Co., *Ogden & Bolan 1677*; Crystal L., Montcalm Co., July 1900, *C. F. Wheeler*; Manistee, Aug. 14, 1884, *Morong*; Pearl L., Benzie Co., *McAtee 3076*. OHIO: Sandusky Bay, July 20, 1895 and Sept. 2, 1898, *E. L. Moseley*; Put-in-Bay, Aug. 1898, *A. J. Pieters*. INDIANA: Wolf L., Hammond, *Agnes Chase 1707*; Clarke, Aug. 28, 1897 and June 29, 1898, *L. M. Umbach*; Lake Maxinkuckee, *Scovell 44*, also *Scovell & Clark 1221*, also *Evermann 1221*. WISCONSIN: Pell L., Bloomfield Twp., Walworth Co., *Hotchkiss & Koehler 4194*; near State House, Trout Lake, Vilas Co., *Fassett 9067 & 9069*; Green Bay, Big Suamico, Aug. 28, 1891 and July 31, 1893, *J. H. Schuette*. ILLINOIS: Edgewater, June 7, 1890, *L. N. Johnson*; Rogers Park, June 7, 1890, herb. *W. H. Dunham*. MANITOBA: 4 mi. w. of Hamiota, *Macoun & Herriot 76868*; Killarney, *Macoun 16441*. MINNESOTA: Green L., Kandiyohi Co., *Metcalf 2050*; Itasca Park, De Soto L., Becker Co., *Grant & Oosting 3272 & 3276*; Snail L., Ramsey Co., *Oosting 28166*; Horn L., Anoka Co., *Oosting 291 & 28100*; Muskeg Bay, Lake of the Woods, Warroad, Roseau Co., *Hotchkiss & Jones 417*; Long L. near Ely, St. Louis Co., *Hotchkiss & Jones 4083*; Pleasant L.,

Stearns Co., *Linsdale & Keck 1*; Dudley L., Rice Co., *Keck & Stilwill 373 & 379*; Birch L., Sherburne Co., *Kubichek 101*; Fish L., Chisago Co., *Kubichek 66*; Borden L., Garrison Twp., Crow Wing Co., *Hotchkiss & Jones 4112*. IOWA: Armstrong, Emmet Co., Aug. 8, 1891, June 20, 1897, and Aug. 21, 1897, *R. I. Cratty*; Lost Island L., Freeman Twp., Clay Co., *Hayden 821*. NORTH DAKOTA: King Slough, s. of Bismark, *Metcalf 345*; Doctor L., Drake, *Mabbott 423*; Spiritwood, *Bergman 443*; Leeds, Benson Co., Aug. 2, 1899, Aug. 21, 1899, and Aug. 16, 1915, *J. Lunell*. SOUTH DAKOTA: South Bass P., Cottonwood L., Spink Co., *Over 17138*; eastern Day Co., *Over 14466*. NEBRASKA: Pelican L., *Thomson 153*; Red Willow L., *Thomson 361 & 365*; Enders L., *Thomson 16*; Dewey L., *Tolstead 615*; Shafer L., Garden Co., *Uhler & Martin 1656*. MACKENZIE: Mosquito Creek and Driftwood R., Great Bear L., 66° 55' N. 121° 20' W., July 6-8, 1928, *A. E. & R. T. Porsild*; Edna Travers Bay, Great Bear L., 66° 25' N. 117° 40' W., *A. E. & R. T. Porsild*. SASKATCHEWAN: vicinity of William Pt., Lake Athabasca, 59° 7' 30" N. 109° 19' W., *Raup 6849*; Little Buffalo L., *J. M. Macoun 2975*; s. of Battleford, *Macoun 2981*. ALBERTA: east end of Crow's Nest Pass, Rocky Mts., *Macoun 23180*; Sand Pt., n. shore of Lake Athabasca, *Raup & Abbe 4614*. MONTANA: Mud L., Bigfork, Flathead L., *M. E. Jones 9293*; Flathead L., Big Fork, Flathead Co., *G. B. & R. P. Rossbach 17*; Whitefish L., Aug. 24, 1892, *R. S. Williams*; Lower Two Medicine Lakes, Glacier Nat'l Park, *Maguire 484*; Echo L., *MacDougal 639*. IDAHO: Priest L., *MacDougal 241*; Lake Pend Oreille, *Sperry & Martin 719*, also *Henderson 4576*; Lake Pend Oreille, near Hope, *Sandberg, MacDougal & Heller 955 & 1026*. WYOMING: Shoshone Creek, Yellowstone, Aug. 23, 1878, *C. Richardson*; Yellowstone L., Yellowstone Park, *Tweedy 411*; Leighs L., Jacksons Hole, *Merrill & Wilcox 902*. COLORADO: Estes Park, Lorimer Co., *Beetle 2341*; South Park, *Wolf 961*; near Boulder, Boulder Co., *Tweedy 4978*. UTAH: Grassy L., Goodman Ranch, Bear R. valley, Uinta Mts., Summit Co., *Hermann 5781*. NEVADA: Ruby L., *Watson 1134*. NEW MEXICO: Petersen Reservoir, Montezuma (Hot Springs), San Miguel Co., *Drouet & Richards 3309*; Chusca Mts., San Juan Co., *Wetmore 550*; Dark Canyon, Guadalupe Mts., *Standley 40649*. ARIZONA: Mormon L., *MacDougal 80* (toward var. *maximus*). CALIFORNIA: Little Hot Springs Valley, Modoc Co., Aug. 18, 1899, *M. S. Baker*; vicinity of Truckee, *A. E. Hitchcock 260*; Truckee R. watershed, Sierra Nevada range, *Benson 4013*. OREGON: Bear Flat, Lake Co., *Leiberg 751*; Guano Ranch, Lake Co., *Coville 602*. WASHINGTON: Lake Washington, Mercer Island, King Co., *Thomson 7589*; Ozette L., Clallam Co., *Otis 1584*; Blakeley Island, San Juan Islands, *S. M. & E. B. Zeller 1237*; Falcon Valley, Aug. 1, 1885, *W. N. Suksdorf* (toward



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var. *myriophyllus*). BRITISH COLUMBIA: Kamloops, *Macoun 2974*; Wellington, Vancouver Island, *John Macoun 88254*; Sproat L., Albernie, Vancouver Island, *Carter 505*. ALASKA: Yes Bay, *Howell 1668*; Fairbanks, *L. J. Palmer 1866*.

9b. *P. GRAMINEUS* L. var. *MAXIMUS* Morong ex Bennett

Var. *maximus* Morong ex Bennett, *Journ. Bot.* **19**: 241 (1881). *P. lonchites* Tuckerm., *Am. Journ. Sci.* ser. 2: **6**: 226 (1848), not Tuckerm., *ibid* ser. 2: **7**: 350 (1849) and subsequent Am. authors. *P. gramineus* var. *maximus* Morong, *Bull. Torr. Club* **13**: 155 (1886), without description. *P. heterophyllus* forma *maximus* Morong, *Mem. Torr. Bot. Club* **3**: no. 2: 25 (1893). *P. gramineus* var. *maximus* Graebn. in Engler, *Pflanzenr.* **4**: fam. 11: 88 (1907). *P. heterophyllus* in part, Taylor, *N. Am. Fl.* **17**: pt. 1: 19 (1909). *P. gramineus* f. *Wolfgangii* sensu Hagstr., *Crit. Res. Pot.* 209 (1916), as to American citations. *P. gramineus* f. *jemtlandicus* sensu Hagstr., *Crit. Res. Pot.* 209 (1916), as to American citations.

Lakes and streams, often in flowing water, with the typical variety and having essentially the same range in North America. MAP 11. Among many collections, the following are the most representative from the areas cited: LABRADOR: 18 mi. up Naskaupi R., Lake Melville Dist., *R. H. Wetmore 103096*. NEWFOUNDLAND: Rushy P., Exploits R., *Fernald, Wiegand, Bartram & Darlington 4477*; Lewisport, Notre Dame Bay, *Fernald, Wiegand & Darlington 4480*. QUEBEC: Lac des Quinze (Baie Gilies), Temiscaming-Abitibi, *Victorin 8194 & 8195*; Roberval, July 16, 1892, *Geo. G. Kennedy*; Deschenes, near Hull, *Malte 118263*; Lac Saint-Jean, *Victorin 16064*. ANTICOSTI: Rivière McKane, *Victorin & Rolland 27095*; Pointe de l'Est, *Victorin & Rolland 27094*. NEW BRUNSWICK: Titusville, *Brittain 2987*; near St. John R., Connors, *Pease 2589*. NOVA SCOTIA: Salmon R., Truro, Colchester Co., *Bean & White 22962*. MAINE: Aroostook R., Ft. Fairfield, July 18, 1893, *Fernald*; St. John R., Ft. Kent, *Mackenzie 3613*; Dead R., Somerset Co., *Fernald & Strong 477*; stream below Dwinall P., Winn, Penobscot Co., *Steinmetz 365*; Stillwater R., Old Town, Penobscot Co., *Ogden & Steinmetz 1602*; Orland R., Orland, Penobscot Co., *Ogden & Marston 1694*. NEW HAMPSHIRE: Connecticut R., Walpole, *Fernald 436*; Connecticut R., near Hanover, July 26 and Aug., 1876, *H. G. Jesup* (not typical). VERMONT: Little Otter Creek, Lake Champlain, Aug. 7, 1880, herb. *E. & C. E. Faxon* (not typical). MASSACHUSETTS: Charles R., Dedham, July 14, 1879 and July 16, 1880, *Morong*, also Aug. 2, 1880, *C. E. Faxon*; Charles R., S. Natick, July 14, 1879 and Sept. 5, 1882, *Morong*; Charles R., Needham, *Tuckerman*; Ashland, July 9, 1879, herb. *Morong*. CONNECTICUT: Quinnipiac R. at Old Turnpike,

Southington, Aug. 17, 1900 and Aug. 17, 1901, *C. H. Bissell*; Housatonic R., near Lake Zoar, Southbury, *E. H. Eames 11745*. NEW YORK: Saranac R., Adirondacks, July 31, 1884, *Morong*; French Creek, Clayton, Jefferson Co., *Muenschler & Maguire 1693*; Hudson R., below Glen Falls, Warren Co., *Muenschler & Lindsey 2769*; Song L., Cortland Co., *Muenschler & Curtis 4841*; Buffalo, *Clinton 5*. NEW JERSEY: Delaware R., Hunterdon Co., Sept. 19, 1885, *T. C. Porter*; Lake Hopatcong, *C. F. Austin* (C, mixed with *P. gramineus* var. *typicus*). PENNSYLVANIA: Penn's Creek at "Swinging Bridge," Selinsgrove, Snyder Co., *Moldenke 4207*. ONTARIO: Dog R., above Michipicoten, *John Macoun 97*; Ottawa R., Rockliffe, *John Macoun 85536*; Ottawa R., *Harrington 99086 & 99102*; Templeton, *Scott 16444*. MICHIGAN: St. Clair R., near Port Huron, *Dodge 155*; Sault R., near Sault Sainte Marie, Aug. 11, 1910, *J. R. Churchill* (not typical). OHIO: Sandusky Bay, Aug. 19 and Aug. 31, 1898, *A. J. Pieters* (not typical, perhaps *P. gramineus* × *P. illinoensis*). WISCONSIN: Wisconsin R., near Lac Vieux Desert, *Cheney 683*; Green Bay near Big Suamico shore, Brown Co., July 11, 1886, *J. H. Schuette* (not typical, perhaps *P. gramineus* × *P. illinoensis*). MINNESOTA: Vermilion L., July 28, 1886, *L. H. Bailey*, also *Arthur, Bailey & Holway B46, B69 & B403*; Garden Island, Lake of the Woods, *MacMillan & Sheldon 1332*; near mouth of Brule R., Cook Co., *Rosendahl & Butters 4638*. IOWA: Armstrong, Emmet Co., July 11 and Aug. 21, 1897, *R. I. Cratty*. NORTH DAKOTA: Leeds, Benson Co., July 2, 1906, *J. Lunell*. MACKENZIE: Edna Travers Bay, Great Bear L., Aug. 8, 1928, *A. E. & R. T. Porsild*. SASKATCHEWAN: along Grand Trunk Pacific R. R., Yorkton, *Macoun & Herriot 76869*. ALBERTA: Murdock Creek Dist., Wood Buffalo Park, *Raup 1546*; L. Mamawi, Wood Buffalo Park, *Raup 1548*. MONTANA: Midvale, *Umbach 457*. IDAHO: Moose Creek, near Big Springs, Fremont Co., *G. B. & R. P. Rossbach 20*. WYOMING: Obsidian Creek, Yellowstone Nat'l Park, *Aven & Elias Nelson 6061*. COLORADO: Trout L., near Lizard Head Pass, San Miguel Co., *Maguire, Piranian & Richards 12771*. UTAH: Salt Lake City, *M. E. Jones 1304*; Dry L., Cache Co., *Maguire 13149*. NEW MEXICO: Chusca Mts., San Juan Co., *Wetmore 549*. ARIZONA: Crater L., San Francisco Mts., Aug. 1886, *Lemmon Herbarium*. CALIFORNIA: Lily L., near Fallen Leaf, Lake Tahoe region, Eldorado Co., *Wiggins 6775*. WASHINGTON: Tumwater Canyon, Wenatchee R., *Sandberg & Leiberg 524*; Camas Land, Wenatchee Mts., Chelan Co., *Thompson 11768*. BRITISH COLUMBIA: Shawnigan L., Vancouver Island, *John Macoun 88253*. ALASKA: Sitka, *Evans 780*; Selawik L., *L. J. Palmer 638* (US, mixed with *P. Richardsonii*).

9c. *P. GRAMINEUS* L. var. *MYRIOPHYLLUS* Robbins

Var. *myriophyllus* Robbins in A. Gray, Man. ed. 5: 487 (1867). *P. heterophyllus* forma *myriophyllus* Morong, Mem. Torr. Club 3: no. 2: 24 (1893). *P. heterophyllus* forma *minimus* Morong, Mem. Torr. Club 3: no. 2: 25 (1893). *P. gramineus* var. *myriophyllus* Graebn. in Engler, Pflanzenr. 4: fam. 11: 87 (1907); Hagstr., Crit. Res. Pot. 209 (1916). *P. gramineus* var. *minimus* Graebn. in Engler, Pflanzenr. 4: fam. 11: 89 (1907). *P. heterophyllus* Taylor, N. Am. Fl. 17: pt. 1: 19 (1909), in part. *P. gramineus* forma *myriophyllus* House, N. Y. State Mus. Bull. 254: 53 (1924).

Quiet water, local in New Hampshire, Massachusetts, Rhode Island, New York, Michigan, Indiana, Wisconsin, Minnesota, and Montana. MAP 12. Although many collections approach this variety, only the following are considered typical: NEW HAMPSHIRE: Lake Winnepesaukee, 1876, *W. F. Flint*. MASSACHUSETTS: Spot P., Stoneham, Aug. 20, 1865, herb. *Wm. Boott*, also July 27, 1876, *Morong*, also Aug. 13, 1880, herb. *E. & C. E. Faxon*; Spot P., Wyoming, Aug. 13, 1880, herb. *C. E. Faxon*; Spot P., Melrose, Aug. 13, 1880, *Edwin Faxon*; Winter P., Winchester, Middlesex Co., *Fernald & Svenson 744*; Wakefield, Sept. 13, 1876, *J. W. Chickering*; Lake Pattaquatic, Ware, Aug. 25, 1905, *E. L. Morris*. RHODE ISLAND: Apponaug P., Apponaug, Oct. 14, 1865, Robbins (TYPE in NY), also Aug. 1879, Sept. 29, 1879 and Aug. 26, 1880, *Morong*, also Aug. 26, 1880, *E. Faxon*, also Aug. 26, 1880 herb. *E. & C. E. Faxon* ("Kingston" appears on the labels, which is an error, for the collection was made at Apponaug in the town of Warwick), also Aug. 24, 1881, *E. Faxon*, also Aug. 25, 1881, *Morong*; Gorton's P. (Apponaug P. of early botanical collectors), Apponaug, town of Warwick, *E. C. & E. B. Ogden 1765*. NEW YORK: Mud P., Pattens Mills, Warren Co., Aug. 25, 1918, *S. H. Burnham*; Friends L., Warren Co., *Muenschler & Lindsey 2775*. MICHIGAN: Sister Lakes, Van Buren Co., *De Selm 22*. INDIANA: Dune Park, *Peattie 2305*. WISCONSIN: Oneida Reservation, Sept. 8, 1881, *J. H. Schuette*; Devils L., Sauk Co., *Fassett 14262*. MINNESOTA: Lake Mora, Kanabec Co., July 1892, *E. P. Sheldon*; Milaca, Mille Lacs Co., July 1892, *E. P. Sheldon*. MONTANA: Bitterroot R., s. w. of Missoula, Missoula Co., *Barkley 1996*.

The extremely variable *P. gramineus* which often approaches in appearance its near relative, *P. illinoensis*, is further complicated by the fact that it hybridizes with most (perhaps all) of the other broad-leaved species of the genus and even one (perhaps more) linear-leaved species. In North America three varieties can be recognized which, though distinct in their extreme de-

velopments, intergrade freely. The variety that appears to be identical with the one upon which the species is based (var. *typicus*) is by far the most common, and is rather widespread in both Europe and North America. Its much branched stem has usually an abundance of small elliptic-lanceolate submersed leaves which distinguish it from all other species of *Potamogeton* as well as from the other varieties of the same species.

The variety *myriophyllus* has a stem even more branched and the leaves still smaller but with parallel margins. This would seem to be but an ecological form were it not found in somewhat different habitats, according to data on labels. When I collected it in Apponaug Pond in 1938 it was exactly like the plants Robbins collected there in 1865.

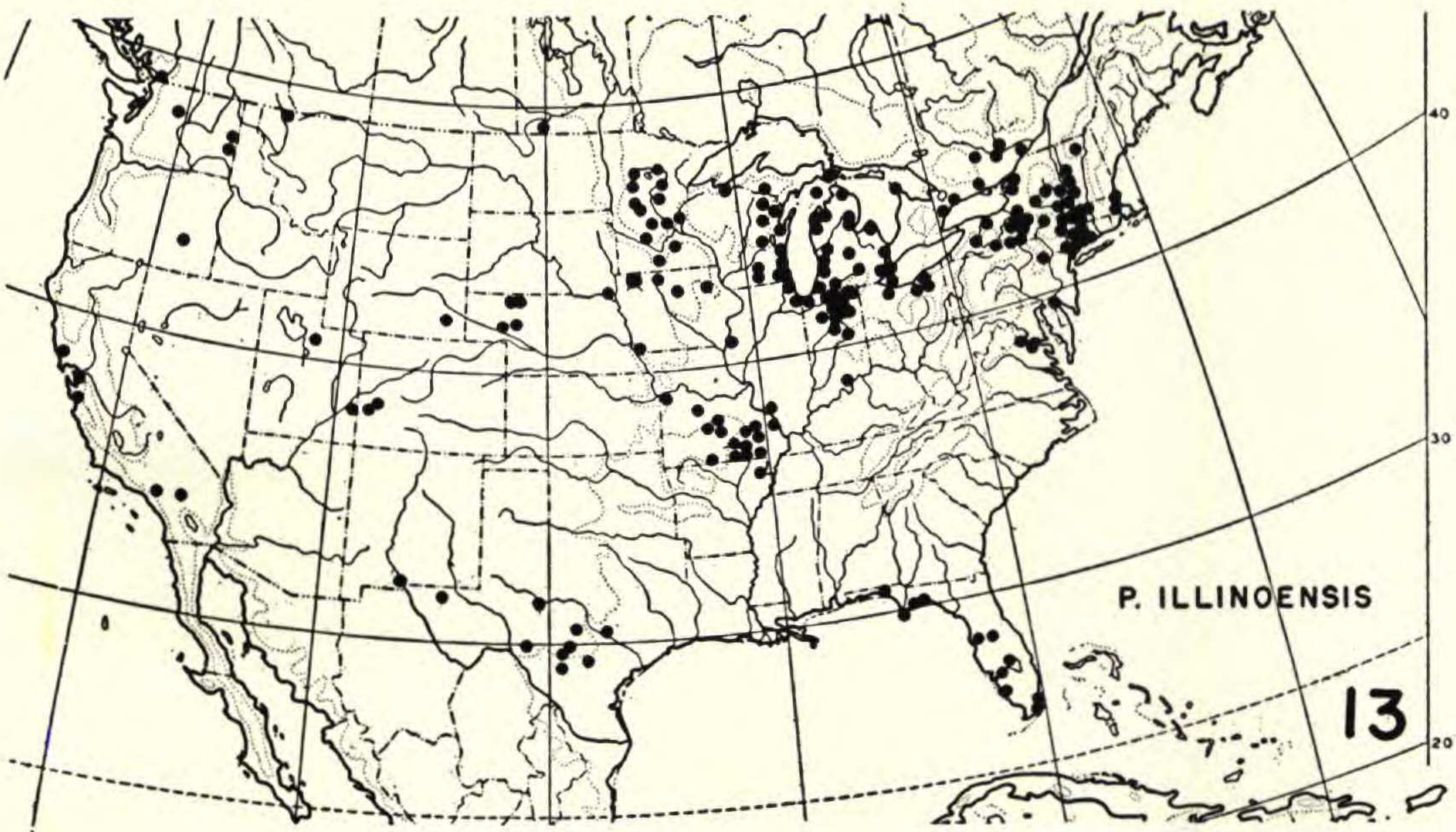
The variety *maximus* is perhaps the most variable one. It differs from the other variants of the species in the larger size of the submersed leaves, less branching of the stem, and usually longer internodes. While for most collections this variety seems to be genetic, for many the condition appears to be ecological. It is oftentimes very difficult to distinguish it from hybrids having *P. gramineus* for one of the parents. It can usually be distinguished from *P. gramineus* \times *P. illinoensis*, which appears most like it, by the more flaccid stem and leaves of the variety.

Plants appearing like typical *P. gramineus* or var. *maximus*, except that the submersed leaves are oblanceolate or spatulate, with the apex rounded, mucronate, or cuspidate (often with many variations on the same plant) occur. These have been called *P. gramineus* var. *spathulaeformis*. The type material upon which this name is based is from the Mystic Lakes, Medford, Mass. and proves to be *P. gramineus* \times *P. illinoensis*. Plants with submersed leaves somewhat similar but usually smaller and with floating leaves usually orbicular or very short-elliptic occur in Newfoundland, Quebec, New Brunswick, Vermont, New York, Ontario, Michigan, Minnesota and Iowa. While the usual stem-anatomy pattern is that of *P. gramineus*, occasionally O-cells are found in the endodermis, thus pointing toward a parent (or grandparent) with an endodermis of O-cells. The broad rounded apex of the submersed leaves and the nearly orbicular floating leaves point to an ancestor with broad rounded leaves. Some of these plants are *P. gramineus* \times *P. perfoliatus*,

others are *P. gramineus* × *P. Richardsonii*, in both cases probably backcrossed with *P. gramineus*. At Moran, Mackinac Co., Michigan, in the shallow water at the northwest end of Brevort Lake, I found typical *P. gramineus* (Ogden & Bolan 1680) and obvious *P. gramineus* × *P. Richardsonii* (Ogden & Bolan 1681, with *Richardsonii*-like submersed leaves and *gramineus*-like floating leaves) and clearly intermediate between the two a plant with oblanceolate submersed leaves (Ogden & Bolan 1681 in Gray Herbarium). See discussion of these hybrids on later pages. Not all oblanceolate-leaved plants are hybrids, however, for leaves of the typical variety or of the variety *maximus* which have been produced at the surface of the water may tend to form a transition to the floating type, which may narrow the lower half and produce a mucro at the apex; in such cases the lower leaves, if submersed, will have the normal shape. Then, too, submersed leaves often have a tendency for the edges of the lower part to curl under, giving the leaf a false oblanceolate shape which close examination will detect.

10. *P. ILLINOENSIS* Morong

RHIZOME buff, spotted, streaked, or suffused with red, as thick as or thicker than the stem. **STEM** simple or branched, terete, but sometimes much flattened when pressed, (1-) 1.5-5 mm. in diameter; stele with the proto-type, trio-type, or oblong-type pattern with (1) 2 central bundles and 2 or more lateral bundles on each side; endodermis of strongly developed U-cells; interlacunar bundles strongly developed in the outer interlacunar circle, sometimes a few in the next to the outer circle; subepidermal bundles present or absent; pseudo-hypodermis absent or 1 cell thick. **SUBMERSED LEAVES** thin, elliptic or oblong-elliptic (sometimes ovate-elliptic) to lanceolate or linear (by the further reduction of the blade to the midrib), often somewhat arcuate; blades 5-20 cm. long, (.2-) 1.5-4 (-4.5) cm. wide, sessile or tapering (except when reduced to midrib) into petioles up to 4 cm. long; apices acute, usually somewhat mucronate; nerves (7-) 9-17 (-19); lacunae of 2-5 rows along midrib and larger nerves; margin with fugacious 1-celled translucent denticles. **FLOATING LEAVES** (often absent) more or less coriaceous, transition to submersed leaves usually gradual; blades elliptic, ovate-elliptic, or oblong-elliptic, 4-13 (-19) cm. long, 2-6.5 cm. wide; apices obtuse, ending in a blunt mucro; bases cuneate or rounded; petioles 2-9 cm. long, shorter than the blade; nerves 13-29; lacunae of 2 or 3 rows of cells along midrib, some-



RANGES OF POTAMOGETON

times obscure. STIPULES persistent, divergent and conspicuous, obtuse, those of the submersed leaves (1-) 2.5-8 cm. long, (.3-.5-1.2 cm. wide at base, prominently 2-keeled, with 15-35 finer nerves; those of the floating leaves broader. PEDUNCLES as thick as or thicker than the stem, 4-15 (-30) cm. long. SPIKES in anthesis more or less compact, of 8-15 whorls of flowers; in fruit cylindric and crowded (2.5-) 3-6 (-7) cm. long, .8-1 cm. thick. FLOWERS sessile or on pedicels up to .5 mm. long; sepaloid connectives orbicular to oval (or reniform), blades (1.3-) 1.6-3 (-3.2) mm. wide, claws 1-1.5 mm. long; anthers oblong, .6-2 mm. long. FRUITS obovate to orbicular or ovate (2.5-) 2.7-3.5 (-3.6) mm. long (excluding beak), (2.1-) 2.2-3 mm. wide; sides flat; keels prominent and acute, the dorsal strongly developed above and below, the laterals less strongly developed but often each with a projecting knob at the base; beak facial, short, erect or curved toward the back; exocarp gray-green to olive-green (rarely brownish); endocarp with keels low but prominent, or with dorsal keel thin and very weak, beak deltoid, very weak, about .5 mm. long, loop solid; apex of seed pointing at about the middle of the opposite side (or between middle and base). A highly variable species in which the extremes appear distinct, but transitional specimens, which are not the exception but the rule, indicate that they are a confluent series.

P. illinoensis Morong, Bot. Gaz. **5**: 50 (1880); Mem. Torr. Club **3**: no. 2: 27 (1893); Graebn. in Engler, Pflanzenr. **4**: fam. 11: 80 (1907); Taylor, N. Am. Fl. **17**: pt. 1: 20 (1909); Hagstr., Crit. Res. Pot. 198 (1916). *P. lucens* of Am. authors; not L., Sp. Pl. 126 (1753). *P. Zizii* of Am. authors, in part; not M. & K. in Röhling, Deutschl. Fl. **1**: 845 (1823); not Koch ex Roth, Enum. Plant. Germ. **1**: 531 (1827). *P. Proteus lucens* C. & S., Linnaea **2**: 197 (1827). *P. Proteus Zizii* C. & S., Linnaea **2**: 201 (1827), in part. *P. lucens* var. *connecticutensis* Robbins in A. Gray, Man. ed. 5: 488 (1867); Morong, Mem. Torr. Club **3**: no. 2: 31 (1893). *P. angustifolius* var. *connecticutensis* Bennett, Journ. Bot. **39**: 199 (1901). *P. Zizii* var. *connecticutensis* Morong ex Bennett, Journ. Bot. **39**: 199 (1901); Graebn. in Engler, Pflanzenr. **4**: fam. 11: 83 (1907). *P. lucens* var. *floridanus* Bennett in Graebn. in Engler, Pflanzenr. **4**: fam. 11: 79 & 161 (1907); Bennett, Journ. Bot. **45**: 374 (1907). ?*P. Zizii* var. *porrectifolius* Bennett in Graebn. in Engler, Pflanzenr. **4**: fam. 11: 83 (1907). ?*P. Zizii* var. *gracilis* Bennett in Graebn. Pflanzenr. l. c. (1907). *Spirillus lucens* Nieuwland, Am. Mid. Nat. **3**: 17 (1913), as to plant, not as to source of name. *Spirillus Zizii* Nieuwland, Am. Mid. Nat. **3**: 17 (1913), in part. *P. illinoensis* forma *rosulatus* Hagstr., Crit. Res. Pot. 199 (1916). *P. illinoensis* forma *homophyllus* Hagstr., Crit. Res. Pot. 199 (1916). × *P. pseudolucens* Hagstr., Crit. Res. Pot. 199 (1916).

? × *P. perplexus* Benn., Trans. & Proc. Bot. Soc. Edinburgh **29**: 53 (1924).

Lakes and streams, southwestern Quebec to southern British Columbia, south to Florida, Texas and California, MAP 13. Mex., Centr. Am., and W. I. Of the very numerous collections, the following are the most typical from the areas cited: QUEBEC: Gatineau R., Wakefield, *Macoun 62021*. VERMONT: Lake Dunmore, Salisbury, Aug. 11 and 31, 1896 and Sept. 2, 1899, *Ezra Brainerd*; Lake Champlain, Sept. 1, 1880, *C. E. Faxon*; Lake Hortonia, Aug. 15, 1896, *Ezra Brainerd*; Barton P., 1829, herb. *Robbins*. MASSACHUSETTS: Fresh P., Cambridge, many collectors; Wenham P., Essex Co., Sept. 21, 1867, *J. W. Robbins*; Leverett P., July 1874, *H. G. Jesup*. CONNECTICUT: Lake Saltonstall, E. Haven, 1845, *Robbins*, also 1850, *Robbins* (G, NY, type collection of *P. lucens* v. *connecticutensis*); Lake Kenosha, Danbury, *E. H. Eames 11351*; Housatonic R., Aug. 1867, *Robbins*; Twin Lakes, Salisbury, Litchfield Co., *Ogden & Bolan 1569*. NEW YORK: Rockland L., July 17, 1892, *Morong*; Lake Cayuga, Cayuga, Aug. 20, 1884, *Morong*; Duck L., Conquest, Cayuga Co., *Eames, Randolph & Wiegand 11175*; bayou back of Renwick Park, Cayuga L., Ithaca, Tompkins Co., *Hitchcock 11175a*; n. of R. R. bridge, Cayuga, Cayuga Co., Oct. 1886, *W. R. Dudley*; Lake Oneida, July 28, 1880, *Miss M. T. Hotchkiss*; Lake Cossayuna, *Dobbin 1112*; Muskalonge Bay, Jefferson Co., *Muenschler & Maguire 1701*; Ballston L., Saratoga Co., *Muenschler & Clausen 4232 & 4233*; Warner L., Albany Co., *Muenschler & Clausen 4238*; Little York L., Preble, Cortland Co., *R. N. Jones 7465*; Greens L., Greene Co., *Muenschler & Curtis 5427*. PENNSYLVANIA: Lehigh, 1876, *E. A. Rau* (ME, "Hanover, Ind." printed on the label). DELAWARE: Stanton, Sept. 4, 1896, *A. Commons*. VIRGINIA: Four Mile Run, Alexandria, June 29, 1903, *I. Tidestrom*; Dyke, Fairfax Co., *Metcalf & Sperry 1690*. NORTH CAROLINA: Orton L., Orton Plantation, 10 mi. n. of Southport, Brunswick Co., Sept. 8, 1941, *R. K. Godfrey* (G). FLORIDA: near the south New R. canal, beyond head of New R., *J. K. & G. K. Small 4437*; near the Miami canal, *J. K. & G. K. Small 4486*; between Cutler and Longview Camp, *Small & Carter 1007*; Royal Palm Park, Dade Co., *Moldenke 752*; near Eustis, Lake Co., Oklawaha R., *Nash 859 & 1750*, also *Curtiss 6692*; Caloosa R., *Simpson 386*; Everglades, Miami R., *Small & Carter 1118* (F, NY, US, type collection of *P. lucens* v. *floridanus*). ONTARIO: Golden L., Renfrew Co., July 28, 1899, *L. M. Umbach*; Pelee Island, Lake Erie, *Macoun 3023*; River Trent, *Macoun 2995*; Elziver, Hastings Co., *Macoun 2996*; Stokes Bay, Tobermory, Bruce Co., *Krotkov 7027*. MICHIGAN: Whitefish L., Mackinac Co., *Metcalf 2317*; n. w. of St. Ignace, Mackinac Co., *Pease & Ogden 24964*; Lake Orion, *Farwell 900*; Houghton L.,

Roscommon Co., June 1876, herb. *C. F. Wheeler*; Swan L., Allegan Co., *Wight 8*; Papaw L., Berrien Co., *C. K. Dodge 171*; Pine L., Clinton Co., *C. F. Wheeler 11 & 24*. OHIO: East Harbor, Ottawa Co., Aug. 10, 1898, *E. L. Moseley*; Bass L., Geauga Co., *Werner 954*; Sandusky Bay, Aug. 31, 1898, *A. J. Pieters*. INDIANA: Old L., Whitley Co., *Deam 49428*; Tippecanoe L., *Scovell 53*; Lake Maxinkuckee, *Scovell 54*, also *Evermann 1079 & 1222*, also *Clark 6*; Lake Maxinkuckee, Culver, Marshall Co., Aug. 27, 1926, *J. R. Churchill*; Pine Station, Lake Co., Aug. 8, 1876, *E. J. Hill*; Clarke, *Umbach*, also *Lansing 1079*; Atwood L., n. w. of Wolcottville, Lagrange Co., *Deam 55350*; Lake Wawasee, Kosciusko Co., *Deam 56396 & 56401*; Lake James, w. of Pokagon State Park, Steuben Co., *Deam 56538 & 56539*. WISCONSIN: Lake Wingra, Dane Co., June 20, 1892, *L. S. Cheney*; White L., near Weyauwega, Waupaca Co., *Hotchkiss & Martin 4432*; Pickerel L., Nashville Twp., Forest Co., *Hotchkiss & Koehler 4331*; Big Muskego L., Muskego Twp., Waukesha Co., *Hotchkiss & Koehler 4245*; Wind L., Norway Twp., Racine Co., *Hotchkiss & Koehler 4226 & 4227*; Pike L., Hartford Twp., Washington Co., *Hotchkiss & Koehler 4262*; Shawano L., Washington Twp., Shawano Co., *Hotchkiss & Koehler 4304*; Lake Noque Bay, Lake Twp., Marinette Co., *Hotchkiss & Koehler 4326*. ILLINOIS: Mississippi River Bottoms near Oquawka, July 23, 1873, Aug. and Sept. 1881, *H. N. Patterson* (TYPE material); Pittsburger L., Centerville, June 29, 1878, *H. Eggert*; Lake Villa, Sept. 28, 1887, *M. B. Waite*. MANITOBA: Souris, July 7, 1883, *J. M. Macoun*. MINNESOTA: Elk L., Itaska Park, Clearwater Co., *Grant & Oosting 3184*; Evans L., Kandiyohi Co., *Metcalf 2377*; Green L., Kandiyohi Co., *Metcalf 2039, 2048 & 2045*; Lake Lizzie, Ottertail Co., *Metcalf 1563*; Rice L., Paynesville, *Metcalf 1427 & 1432*; Koronis L., Stearns Co., *Metcalf 1379, 1383 & 1391*, also *Kubichek 110, 114, 115 & 121*; Swan L., Nicollet Co., *Metcalf 8*; Martin L., Anoka Co., *Metcalf 1329*; Birch L., Sherburne Co., *Metcalf 1370*; Horseshoe L., Chisago Co., *Kubichek 71 & 72*; Prior L., Scott Co., *Oosting 2938*; Lake Ida, Douglas Co., *Uhler & Warren 858*; Lake Julia, Sherburne Co., *Keck & Stevens 280*; Borden L., Garrison Twp., Crow Wing Co., *Hotchkiss & Jones 4113*; Center City, Aug. 1892, *B. C. Taylor*; Two Inlet L., Becker Co., *Shunk & Manning 237*. IOWA: Armstrong's Grove, Emmet Co., July 21, 1882, *R. I. Cratty* (cotype collection of *P. illinoensis*); Fayette, July 1894, *B. Fink 191*; Fremont Co., Aug. 2, 1898, herb. *T. J. & M. F. L. Fitzpatrick*; Clear L., Cerro Gordo Co., July 11, 1896, *B. Shimek*. MISSOURI: Fish L., Sibley, Jackson Co., *Mackenzie 293*; Gasconade R., between Falcon and Nebo, Laclede Co., *Steyermark 13910*; Current R., n. of Buffalo Creek, e. of Bennett, Ripley Co., *Steyermark 14285*; Phillips Spring, s. e. of Van Buren, Carter Co., *Steyermark 21235*;

Marble Creek, s. of French Mills, St. Francois Purchase Unit, Clark Nat. Forest, Madison Co., *Steyermark* 21087. ARKANSAS: St. Francis R., Paragould, Greene Co., June 27, 1893, *H. Eggert*. SOUTH DAKOTA: water hole near Missouri R., Clay Co., *Over* 4008. NEBRASKA: Rat L., *Thomson* 53; Swan L., s. of Whitman, Grant Co., *Rydberg* 1440; Shafer L., Garden Co., *Uhler & Martin* 1662; Hackberry L., Cherry Co., *Thomson* 145, also *Sharp* 11; Dewey L., Cherry Co., *Tolstead* 614. TEXAS: Guadalupe R., Kerrville, Kerr Co., *E. J. Palmer* 12217; 16 mi. n. of Leakey, Real Co., *Cory* 8502; San Antonio, *Thurber* 48; Montell Creek, Uvalde, *Cory* 9800; McKittrick Canyon, Guadalupe Mts., Culberson Co., *Moore & Steyermark* 3667 (not typical). WYOMING: Laramie R., *Elias Nelson* 3386. COLORADO: Tabequache Basin, *Payson* 174; Cerro Summit, region of Gunnison Watershed, *Baker* 427. UTAH: Twelve Mile Cañon, Wasatch Mts., *Tidestrom* 517. NEW MEXICO: San Augustine Ranch, Organ Mts., Dona Ana Co., July 10, 1909, *E. O. Wooton*. CALIFORNIA: Marine Hospital, San Francisco, June 27, 1892, *J. W. Blankinship*; Mission Dolores, *Bolander* 274; near Sebastopol, Sonoma Co., Aug. 1900, *M. S. Baker*; Mountain L., San Francisco, Aug. 22, 1920, *Alice Eastwood* (not typical). OREGON: creeks, western Oregon, 1880, *T. J. Howell*; in a warm spring, Harney Valley, June 10, 1885, *Thomas Howell* (F, mixed with *P. alpinus* v. *tenuifolius*, C, G, US, not mixed). WASHINGTON: Lake Chelan, Washington Forest Reserve, *Gorman* 703; Turnbull Slough, Spokane Co., *Sperry & Martin* 731. BRITISH COLUMBIA: Sumas L., Chilliwack Valley, *J. M. Macoun* 26815 (perhaps a hybrid; type of \times *P. perplexus* in C, isotypes in G, NY).

The highly complex species, *P. illinoensis*, has been variously treated by students of the genus. Morong¹ restricted the name to two collections of those known to him: Oquawka, Ill., collected by H. N. Patterson, and Armstrong's Grove, Iowa, collected by R. I. Cratty. Both plants are very robust and evidently grew in shallow, quiet, rich, muddy water. He complained that some botanists doubted the validity of *P. illinoensis* as a distinct species, but argued that it ". . . is evidently allied to *lucens* in habit, and with that species, *P. angustifolius*, *P. spathuliformis* and *P. heterophyllus*, forms a very natural group, but it is clearly distinct from all of them in its vigorous growth, its abundant foliage, its ample floating and submerged leaves, and its large, strongly 3-keeled fruit."² Of these characters, the only one that can be considered of specific importance is that per-

¹ Thomas Morong, Mem. Torr. Club, 3: no. 2: 27 (1893).

² Thomas Morong, Mem. Torr. Club 3: no. 2: 28 (1893).

taining to the fruit, and examination shows that the fruits of the plants in this country called *P. lucens* or *P. angustifolius* are as strongly 3-keeled as those of *P. illinoensis*. Graebner's treatment of this group is quite artificial. He followed Morong's grouping rather closely but recognized numerous subspecies, varieties, subvarieties, and forms to account for the minor divergencies. The name *P. illinoensis* was, however, confined to the two original collections. Hagström evidently made a genuine attempt to understand the complex. Lack of sufficient material greatly handicapped him. He was misled by previous treatments into believing that *P. lucens* occurs in this country, but cited no specimens. Morong, who had realized that the plants he referred to *P. lucens* did not match any of the European forms of that species, treated them as var. *connecticutensis*. Hagström ignored this, except to question its being a variety of *P. lucens*, and does not even include it as a synonym. Some sterile specimens in North America resemble *P. lucens* of Europe but they lack the tendency for the lower leaves to have the blades reduced at the apex so that the midrib extends well beyond as a cusp. When mature fruits are obtained, the keels are seen to be prominent and acute (those of *P. lucens* are low and rounded) and the beak is more facial. Interestingly enough, specimens with mature fruit do not have the compact, bushy habit of *P. lucens* and would not be confused with that species.

Hagström considered *P. angustifolius* (*P. Zizii*) to be the hybrid *P. gramineus* × *lucens*, a belief held or suspected by many students of the genus. He cites specimens from North America but calls attention to the fact that “. . . many *Zizii*-like North American plants are not at all this hybrid, but of another origin, and great carefulness is necessary when considering these difficult forms.”¹ If *P. lucens* does not occur in this country, the hybrid *P. gramineus* × *lucens* must be absent also. It may be suspected that the hybrid *P. gramineus* × *illinoensis* is not uncommon with us for it is known that each of these closely related species hybridizes with species of other subsections. Many intermediate forms occur, but it is usually difficult to determine which are the results of crossing and which are ecological variants of one or the other species.² The plants of the subsection *Lucentes*

¹ J. O. Hagström, Crit. Res. Pot. 216 (1916).

² See discussion under HYBRIDISM.

fruit as freely as the average species of *Potamogeton*, and I think that nearly all of them must be considered to belong to one or the other of the two species.

The earliest specific name for the large-leaved plant is *P. illinoensis* Morong. This species has several variants, the recognition of which is made difficult in that ecological forms of one may simulate normal states of another. The *Lucentes* need to be studied cytologically and, until the hybrids having *P. illinoensis* as a parent are better understood, a grouping of the variants into varieties would be merely an artificial one. In order not to delay this treatment further, *P. illinoensis* is treated in the broad sense, including its many variations.

11. *P. PRAELONGUS* Wulfen

RHIZOME whitish, suffused or spotted with rusty red, as thick as the stem or often much thicker. **STEM** simple or branched, whitish or olive-green, often zigzag, 1.5–4 mm. in diameter; stele with the proto-type pattern; endodermis of U-cells; interlacunar and subepidermal bundles present; pseudo-hypodermis 1–3 cells thick. **LEAVES** all submersed, ovate-oblong, (5–) 10–20 (–36) cm. long, 1–3 cm. wide, 13–25 nerves, 3–7 of them more prominent than the others, cordate or rounded at base and clasping $\frac{1}{3}$ or $\frac{1}{2}$ the circumference of the stem; apex cucullate, splitting when pressed, or rounded; margin entire; lacunae of 2–4 rows of cells each side of the midrib. **STIPULES** white, nerves moderately strong, oblong to oblong-linear or ovate-lanceolate, rounded at apex, (3–) 5–10 cm. long, without keels, usually persistent and conspicuous. **PEDUNCLES** variable in thickness, clavate, (5–) 15–60 cm. long. **SPIKES** with 6–12 whorls, not crowded at anthesis, sometimes moniliform; in fruit 3–5 cm. long, 1.1–1.4 cm. thick. **FLOWERS** sessile or on pedicels up to .5 mm. long; sepaloid connectives greenish, blades orbicular or elliptical, (1.7–) 2–2.6 (–2.9) mm. wide, claws 1–2 mm. long; anthers 1–2 mm. long. **FRUITS** obovate, rounded on the back, cuneate at base, (4–) 4.3–5 mm. long (excluding beak), 3.2–4 mm. wide; beak prominent, short and thick; dorsal keel acute and strongly developed, especially upward; lateral keels rounded or none; exocarp dark green; endocarp with rounded lateral keels and a dorsal keel which is alate, thin and weak, beak linear, facial, about .8 mm. long, loop with a linear cavity; apex of seed pointing toward the basal end or slightly above. Plants characterized by large ovate-oblong leaves, cucullate at the tip, whitish stem, large conspicuous stipules, and with long peduncles bearing large fruits.

P. praelongus Wulf., Arch. Bot. Roem. **3**: 331 (1805); Benn., Journ. Bot. **19**: 241 (1881); Morong, Mem. Torr. Club **3**: no. 2: 32 (1893); Graebn. in Engler, Pflanzenr. **4**: fam. 11: 96 (1907); Taylor, N. Am. Fl. **17**: pt. 1: 22 (1909); Hagstr., Crit. Res. Pot. 250 (1916). *Spirillus praelongus* Nieuwl., Am. Midl. Nat. **3**: 17 (1913).

Deep, cold water, southern Labrador, Newfoundland, Gaspé Peninsula, Prince Edward Island, New England, and New Jersey, west to California, and north to Alberta, Mackenzie and the Aleutian Islands. MAP 14. Eurasia. Reported from Mexico. The following, from a large series of specimens, are representative: LABRADOR: Trout P., Blanc Sablon R., Straits of Belle Isle (also on the Quebec side of the river), *Fernald & Long 27347*. NEWFOUNDLAND: Cook Point, Pistolet Bay, *Fernald, Gilbert & Hotchkiss 27346*; Tilt Cove, northern shores of Notre Dame Bay, *Fernald, Wiegand & Darlington 4482*; Birchy Cove (Curling), Region of Humber Arm, Bay of Islands, *Fernald, Wiegand & Kittredge 2441*; Middle Birchy P., eastern drainage area of the Humber R. system, *Fernald & Wiegand 2444* (C, G, flaccid form); Morley's P., Humber Arm, Bay of Islands, *Fernald, Long & Fogg 1211*; Junction P., Whitbourne, Avalon Peninsula, *Fernald, Long & Dunbar 26223*. QUEBEC: Lac Pleureuse, Gaspé Co., *Fernald, Dodge & Smith 25423 & 25424*; West Branch of Mont Louis R., Gaspé Co., *Fernald, Dodge & Smith 25422*; Lac Sainte-Anne, Gaspé Co., *Victorin, Rolland & Jacques 33518*; New-Richmond, Bonaventure Co., *Victorin, Rolland & Jacques 33838*; Lac Porc-Épic, Saint-Fabien, Rimouski Co., *Rousseau 30004*. PRINCE EDWARD ISLAND: Dundee, Kings Co., *Fernald, Long & St. John 6767*; French River, Queens Co., *Fernald, Long & St. John 6768*. NEW BRUNSWICK: Woodstock, Aug. 1884, *Geo. U. Hay 4131*. NOVA SCOTIA: Earltown Lakes, Aug. 10, 1883, *McKay 4129*. MAINE: Houlton, Aroostook Co., 1881, *Furbish*; 5th Lake Musquacook, Piscataquis Co., *G. B. Rossbach 82*; St. John P., Somerset Co., *St. John & Nichols 2107*; Pushaw L., Orono, Penobscot Co., Aug. 1891, *Furbish*; Hammond P., Hampden, Penobscot Co., *Ogden & Steinmetz 1604*; Hermon P., Hermon, Penobscot Co., *Ogden, Babel & Kozicky 1880* (flaccid form); Pleasant P., Stetson, Penobscot Co., *E. C. & E. B. Ogden & F. H. Steinmetz 1882, Gray Exsic. no. 1105*; Androscoggin R., Livermore Falls, Androscoggin Co., 1894, *Furbish*; Torsey P., Kent's Hill, Readfield, Kennebec Co., 1892, *Furbish*. NEW HAMPSHIRE: Ladd P., Stewartstown, *Pease 14012*; Streeter's P., Lisbon, June 18, 1887, ex herb. *E. & C. E. Faxon*; Round P., Connecticut Lakes, *Kendall, Gouldsborough & Doolittle 17*. VERMONT: Shelburne P., June 28, 1878, *Pringle*; Harvey's P., West Barnet, Sept. 7, 1885, *F. Blanchard*; Willoughby, Orleans Co., Aug. 31, 1904, *A. Lorenz*. MASSACHUSETTS: Chadwick's P., Essex Co.,

S. K. Harris 539; Pleasant L., Hamilton, Essex Co., *Fernald & Svenson* 749; Fresh P., Cambridge, Middlesex Co., *many collectors*; Harmon P., New Marlboro, Berkshire Co., June 29, 1912, *R. Hoffmann*; Stockbridge Bowl, Stockbridge, Berkshire Co., Aug. 9, 1914, *R. Hoffmann*. CONNECTICUT: Bantam L., Litchfield, Litchfield Co., July 25, 1883, *Morong*; Lake Saltonstall, Sept. 23, 1880, *E. & C. E. Faxon*; Twin Lakes, North Branford, New Haven Co., June 22, 1887, *E. B. Harger*; Twin Lakes, Salisbury, Litchfield Co., *Eames & Godfrey* 8685. NEW YORK: Southeast Bay, Saratoga L., Saratoga Co., *Muenschler & Lindsey* 2819; Dexter L., St. Lawrence Co., *Muenschler & Maguire* 829; Lake Placid, Essex Co., *Muenschler, Manning & Maguire* 141; Cayuga L., Tompkins Co., July 29, 1884, *Dudley*; Pierrepont P., inlet from Lake Ontario, Woodville, Jefferson Co., *House* 10070; Ballston L., Saratoga Co., *Muenschler & Clausen* 4205. NEW JERSEY: Swartswood L., Sussex Co., *Griscom & Mackenzie* 10681. ONTARIO: Lake Hannah, Nipigon R., July 21, 1884, *John Macoun*; Lake Scugog, *Wm. Scott* 16451, also *Cain* 972; Inner Long Point Bay, Lake Erie, *Cain* 1050; Almonte, July 6, 1898, *J. Fowler*. MICHIGAN: Isle Royale, *Cooper* 312; Lake Manganese, Copper Harbor, Keweenaw Co., *Hermann* 8234; Tahquamenon R., Luce Co., *Metcalf* 2291; Douglas L., Cheboygan Co., *Ehlers* 533 & 1756, also June, July 1924, *J. R. Swallen*; Fremont L., Newago Co., July 7, 1926, *Oosting*; Crystal L., Montcalm Co., *C. F. Wheeler* 273; Pine L., vicinity of Agr'l Coll., *C. F. Wheeler* 10; Haslet, *Yuncker* 713; Vicksburg, Kalamazoo Co., July 5, 1937, *F. W. Rapp*; Clear L., Jackson Co., *Hermann* 6281. OHIO: Put-in-Bay, July 16, 1898, *A. J. Pieters*. INDIANA: Bear L., Noble Co., *Deam* 49394; Wolf L., *Agnes Chase* 1466; Lake Maxinkuckee, *Scovell* 45 & 66; near Lake Maxinkuckee, *Scovell & Clark* 1321. WISCONSIN: Green Bay, 1892, *Schuetz*; Twin Lakes, Marquette Co., *Uhler & Warren* 1079; Big Muskego L., Muskego Twp., Waukesha Co., *Hotchkiss & Koehler* 4246; Wind L., Norway Twp., Racine Co., *Hotchkiss & Koehler* 4228; Rice L., Nashville Twp., Forest Co., *Hotchkiss & Koehler* 4340; valley of the Wisconsin R., near Lac Vieux Desert, *L. S. Cheney* 499; Lauderdale, *Bebb* 1009. MINNESOTA: Burntside L., July 25, 1886, *L. H. Bailey*; Lake Itasca, Clearwater Co., *Grant* 3029; Swan L., *Hotchkiss & Jones* 3928; Center City, Chisago Co., July 1892, *B. C. Taylor*; Lake Chisago, *Metcalf* 1229; James L., Kandiyohi Co., *Metcalf* 2387; Geneva L., Freeborn Co., *Shunk & Manning* 80; German L., LeSueur Co., *Shunk & Manning* 229; Leaf L., Becker Co., *Shunk & Manning* 368; Christine L., Douglas Co., *Shunk & Manning* 410; Pelican L., Wright Co., *Linsdale & Keck* 153, also *Uhler & Warren* 797½; Child L., Cass Co., *Metcalf* 2371; Lake Johanna, Pope Co., *Keck & Stilwill* 455. IOWA: Clear L., Cerro Gordo Co., July 11, 1896, *B. Shimek*. NORTH

DAKOTA: Roland Twp., Turtle Mts., Bottineau Co., *Metcalf 522*; Pelican L., Turtle Mts., Bottineau Co., *Metcalf 546*. NEBRASKA: Hackberry L., Cherry Co., July 18, 1912, *Pool & Folsom*; Dewey L., near Valentine, *Tolstead 430*; Enders L., *Thomson 2*. MACKENZIE: 2nd Eskimo L., 68° 10' N., 132° 55' W., Aug. 19, 1927, *A. E. & R. T. Porsild*. ALBERTA: Moose Lake district, Wood Buffalo Park, *Raup 1570 & 1571*; Murdock Creek district, Wood Buffalo Park, *Raup 1572*. MONTANA: Lower Two Medicine Lakes, *Maguire 485*; Lower St. Mary's L., *Maguire 486*. IDAHO: Henry L., Fremont Co., *E. B. & L. B. Payson 2024*; Gray's L., *Sperry & Martin 696*. WYOMING: Swastika L., Medicine Bow Mts., Albany Co., *A. & R. A. Nelson 973*, also *R. J. Davis 378-W*; Heart L., Yellowstone Nat'l Park, *Clifford Richardson*. COLORADO: Cottonwood L., *Shear 3804*; vicinity of Twin Lakes, July-Aug. 1902, *C. Juday*; Echo L., s. w. of Idaho Springs, Clear Creek Co., *Ehlers 7957*. UTAH: Panguitch L., *M. E. Jones 6023*, Fish L., Fish Lake Forest, July 23, 1922, *S. B. Locke*; Posey L., 14 mi. n. of Escalante, Garfield Co., Sept. 3, 1936, *Geo. Piranian*. CALIFORNIA: Webber L., Sierra Co., Aug. 1894, *Dudley*; Lassen's Peak, July 1879, *Mrs. R. M. Austin*. OREGON: Wallowa L., *Cusick 2484*; Klamath marsh, Klamath Indian Reservation, *Coville 1254*. WASHINGTON: Wiser L., Whatcom Co., *Muenscher 7647*; Lake Leland, Jefferson Co., *Otis 1767*. BRITISH COLUMBIA: Langford L., Vancouver I., *John Macoun 4132a & 88257*; Beaver L., near Victoria, *John Macoun 88258 & 88259*. ALASKA: Atka, Aleutian Islands, *Eyerdam 948 & 1122*.

P. praelongus is a beautiful species with large bright green oblong leaves, and it often has extremely long peduncles terminated by huge spikes with massive fruit. It can scarcely be mistaken for any other species. Bennett¹ quotes remarks from Morong to the effect that this species fruits very late (Nov. to Dec.). However, specimens in herbaria with fruit are mostly collected in July and August. Robinson and Fernald say, "Fruiting in June and July, withdrawing the stems to deep water to mature the fruit,"² and this seems to be the case. More June collections of this plant are desirable. An extremely flaccid form (*forma elegans* Tiselius) was collected in Newfoundland by Fernald and Wiegand (*Fern. & Wieg. 2444*); one much like it grows in Hermon P., Maine (*Ogden, Babel & Kozicky 1880*).

12. *P. RICHARDSONII* (Bennett) Rydberg

RHIZOME whitish, yellowish or pinkish, not spotted; scales blackish, rounded at apex. STEM often branched, unspotted,

¹ Arthur Bennett, *Journ. Bot.* 19: 241 (1881).

² Robinson & Fernald, *Gray's Man.* ed. 7: 74 (1908).

1–2.5 mm. in diameter; stele with the trio-type pattern, the phloem on the inner face of the trio-bundle appearing as 2 patches; endodermis of O-cells; interlacunar and subepidermal bundles absent; pseudo-hypodermis 1 cell thick, at least partly so. LEAVES all submersed, coarse, mostly ovate-lanceolate, often ovate at the lower part of the stem and becoming narrowly lanceolate above, (1.5–) 3–10 cm. long, (.5–) 1–2 cm. wide, nerves (7–) 17–29 (–33), all rather prominent, 3–7 of them more prominent than the others, cordate at base and clasping $\frac{1}{2}$ or $\frac{3}{4}$ the circumference of the stem; apex acutish but never sharp-pointed, sometimes rounded; margin with fugacious 1-celled translucent denticles, which are usually more or less appressed, lacunae of 2 or 3 rows of cells each side of the midrib. STIPULES whitish, coarsely nerved, ovate to lanceolate, obtuse when young, 1–2 cm. long, without keels, early disintegrating into whitish fibers. PEDUNCLES at base about same thickness as stem, often clavate, 1.5–25 cm. long. SPIKES with 6–12 whorls, not crowded at anthesis, sometimes moniliform; in fruit 1.5–4 cm. long, and about 1 cm. thick. FLOWERS sessile or on pedicels up to .5 (–1) mm. long; sepaloïd connectives greenish, blades orbicular or elliptical, (1.3–) 1.4–2 (–2.3) mm. wide, claws usually 1–1.5 mm. long; anthers (.8–) 1.1–1.3 (–1.4) mm. long. FRUITS obovate, rounded on the back and at the base, sides plump or with a shallow depression, (2.5–) 2.7–3.2 (–3.5) mm. long (excluding beak), (2–) 2.3–2.6 (–3) mm. wide; beak prominent, up to 1 mm. long; keels rounded or none, rarely acutish; exocarp usually gray-green or olive-green; endocarp with rounded keels, beak linear, facial, about .8 mm. long, loop with a cavity, or at least a weak area; apex of seed pointing toward the basal end or slightly above. Plants characterized by numerous coarsely-nerved perfoliate submersed leaves, with stipules persistent as whitish fibers.

P. Richardsonii (Benn.) Rydb., Bull. Torr. Club **32**: 599 (1905). *P. perfoliatus* var. *lanceolatus* Robb. in Gray, Man. ed. 5: 488 (1867); not Blytt (1861). *P. perfoliatus* var. *Richardsonii* Benn., Journ. Bot. **27**: 25 (1889); Morong, Mem. Torr. Club **3**: no. 2: 33 (1893); Graebn. in Engler, Pflanzenr. **4**: fam. 11: 95 (1907). *P. perfoliatus* L. sensu Taylor, N. Am. Fl. **17**: pt. 1: 22 (1909), in part; sensu Hultén, Fl. Alaska & Yukon 101 (1940). *P. perfoliatus* var. *gracilis* sensu Fernald in Porsild, RHODORA **41**: 176 (1939). *Spirillus perfoliatus* var. *Richardsonii* (Benn.) Nieuwl., Am. Mid. Nat. **3**: 17 (1913). *P. perfoliatus* ssp. *Richardsonii* Hultén, Fl. Alaska & Yukon 102 (1940).

Deep water of lakes and rivers, Labrador, Quebec, northern Maine, Vermont and western Massachusetts, west to Utah and California, north to British Columbia, Mackenzie, Alaska and the Aleutian Islands. MAP 15.

(To be continued)